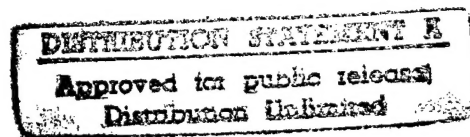


**Limited Energy Study
Energy Engineering Analysis Program (EEAP)
Rock Island Arsenal**

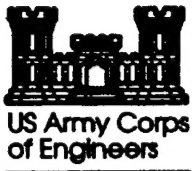
Final Report



CONTRACT # DACA27-93-C-0096
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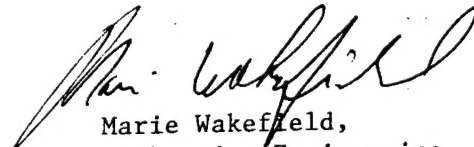

Marie Wakefield,
Librarian Engineering

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1 Executive Summary

1.1 PURPOSE

The purpose of this limited energy survey is to evaluate Energy Conservation Opportunities (ECOs) at three locations at Rock Island Arsenal. The three ECOs evaluated are:

1. Lighting efficiency improvements in Building 220.
2. Lighting efficiency improvements in Building 350.
3. Cogeneration/Peak-Shaving Installation at Buildings 160 and 168.

Table 1.1.1 shows the buildings surveyed, building types, and their square footages.

1 Executive Summary

TABLE 1.1.1		
BUILDINGS SURVEYED		
BUILDING TYPE	BUILDING NUMBER	BUILDING AREA
Administrative	350	453,600
TOTAL AREA THIS TYPE		453,600
Machine Shop	220	536,970
TOTAL AREA THIS TYPE		536,970
Hydro Electric Plant	160	30,894
TOTAL AREA THIS TYPE		30,894
Old Steam Plant	168	8,349
TOTAL AREA THIS TYPE		8,349

1 Executive Summary

1.2 PRESENT ENERGY CONSUMPTION

Using computerized techniques, the present energy consumption for each ECO was evaluated using data gathered during the field survey (September 7-10, 1993). The present energy consumption totals for each ECO are presented in *Table 1.2.1*.

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TABLE 1.2.1		
ENERGY BASELINE FOR ALL ECOs		
ECO NUMBER	ECO NAME	BASELINE ENERGY CONSUMPTION (SOURCE-MBTU)
1A	FLUORESCENT FIXTURE REPLACEMENTS - BUILDING 220	35,616 (ELEC)
1B	FLUORESCENT FIXTURE RETROFIT - BUILDING 220	35,616 (ELEC)
1C	MERCURY VAPOR FIXTURE REPLACEMENTS - BUILDING 220	6,980 (ELEC)
1D	EXIT SIGN RETROFIT - BUILDING 220	176 (ELEC)
2A	FLUORESCENT FIXTURE REPLACEMENTS - BUILDING 350	6,650 (ELEC)
2B	OCCUPANCY SENSOR INSTALLATION - BUILDING 350	2,218 (ELEC)
2C	FLUORESCENT FIXTURE REPLACEMENTS - BUILDING 350	59,580 (ELEC)
2D	INCANDESCENT FIXTURE REPLACEMENTS - BUILDING 350	1,354 (ELEC)
2E	EXIT SIGN RETROFITS - BUILDING 350	315 (ELEC)
3A	INSTALL 1 MW PEAK-SHAVING GENERATOR - BUILDING 160	2,396,700 (ELEC)
3B	INSTALL 6 MW PEAK-SHAVING GENERATOR - BUILDING 160	2,753,400 (ELEC)
3C	INSTALL 24 MW BASELOADED GENERATOR - BUILDING 168	2,397,000 (ELEC) & 1,121,200 (COAL)

1 Executive Summary

1.3 ECOs INVESTIGATED

The three ECOs were further subdivided into 12 separate ECOs as follows:

ECO - 1A: Fluorescent Fixture Replacements in Building 220.

ECO - 1B: Fluorescent Fixture Retrofits in Building 220.

ECO - 1C: Mercury Vapor Fixture Replacements in Building 220.

ECO - 1D: Exit Sign Retrofits in Building 220.

ECO - 2A: Fluorescent Fixture Replacements in Building 350 - Perimeter Office Area

ECO - 2B: Occupancy Sensor Installation in Building 350 - Perimeter Office Area

ECO - 2C: Fluorescent Fixture Replacements in Building 350 - Core Area

ECO - 2D: Incandescent Fixture Replacements in Building 350

ECO - 2E: Exit Sign Retrofits in Building 350

ECO - 3A: 1 MW Peak-Shaving Gas Engine at Building 160

ECO - 3B: 6 MW Peak-Shaving Gas Turbine at Building 160

ECO - 3C: 24 MW Cogeneration Plant at Building 168

Table 1.3.1 lists the results of each of these 12 ECOs evaluated, ranking each by savings-to-investment ratios (SIRs). *Table 1.3.2* lists only the ECOs that can be recommended. *Table 1.3.3* shows the non-recommended ECOs and the justification for not recommending each. *Table 1.3.4* groups the recommended ECOs by building, which is the method of grouping used in preparing the ECIP programming documents.

1 Executive Summary

TABLE 1.3.1			
ALL ECOs RANKED BY SIR			
ECO NUMBER	BUILDING NUMBER	ENERGY SAVINGS (MBTU-SOURCE)	S I R
1D	220	164	8.0
2E	350	291	8.0
1C	220	3424	2.5
2D	350	1062	2.3
2C	350	51225	2.1
1B	220	20054	1.6
2B	350	1109	1.5
1A	220	21724	1.4
2A	350	4432	1.3
3C	168	1275566	1.0
3A	160	-2349	0.5
3B	160	71550	0.1

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TABLE 1.3.2 RECOMMENDED ECOs RANKED BY SIR			
ECO NUMBER	BUILDING NUMBER	ENERGY SAVINGS (MBTU) (SOURCE)**	SIR
1D	220	164	8.0
2E	350	291	8.0
1C	220	3424	2.5
2D	350	1062	2.3
2C	350	51225	2.1
1B	220	20054	1.6
2B	350	1109	1.5
1A	220	21724	1.4
2A	350	4432	1.3
3C	168	1275566	1.0

TOTALS* 1,379,051 MBTU 1.3 OVERALL SIR

*TOTAL EXCLUDES ECO-1B SINCE ECO-1A WAS THE PREFERRED ALTERNATIVE.

**SOURCE ELECTRICITY = SITE ELECTRICITY * 11,400/3,413

1 Executive Summary

TABLE 1.3.3			
NON-RECOMMENDED ECOs RANKED BY SIR			
ECO NUMBER	BUILDING NUMBER	REASON FOR NOT RECOMMENDING	S I R
3A	160	SIR IS LESS THAN 1.0	0.5
3B	160	SIR IS LESS THAN 1.0	0.1

1 Executive Summary

TABLE 1.3.4
RECOMMENDED ECOs BY BUILDING

BUILDING NUMBER	ECO NUMBER	INVESTMENT COST (\$)	ANNUAL SAVINGS (\$)	SIMPLE PAYBACK YEARS
168	3C	16,199,000	2,844,423	5.7
TOTAL BUILDING 168	3C	16,199,000	2,844,423	5.7
220	1A	1,003,000	177,222	5.7
220	1B	739,000	147,001	5.0
220	1C	59,000	21,723	2.7
220	1D	4,000	2,473	1.6
TOTAL BUILDING 220*	1A, 1C, 1D	1,066,000	201,418	5.3
350	2A	313,000	51,508	6.1
350	2B	27,000	3,366	8.0
350	2C	975,000	249,963	3.9
350	2D	43,000	8,312	5.2
350	2E	6,400	4,431	1.4
TOTAL BUILDING 350	2A - 2E	1,364,000	317,580	4.3
TOTAL*	1A, 1C, 1D 2A - 2E, 3C	18,629,000	3,363,421	5.5

* TOTAL EXCLUDES ECO-1B SINCE ECO-1A WAS THE PREFERRED ALTERNATIVE.

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The following is a description of each of the twelve ECOs evaluated.

1.3.1 ECO-1A: Fluorescent Fixture Replacements in Building 220

This ECO evaluated the feasibility of changing out all the existing 4- and 8-foot T-12 fluorescent fixtures in Building 220 and replacing them with new 4-foot T-8 fluorescent fixtures utilizing high efficiency lamps, ballasts, and reflectors. The new system provides the same light output as the existing system in all areas, and in many cases provides more light than currently provided. This ECO provides a one-for-one fixture replacement, however the number of lamps has been reduced due to reflector usage. The existing 8-foot fixtures are replaced by two 4-foot fixtures. The existing 8-foot fixtures were a conglomeration of standard wattage (60 watt), high output (110 watt), and very high output (215 watts) lamps, all using standard efficiency ballasts. The existing 4-foot fixtures were mainly economy watt (32 watt) bulbs with some very high output (115 watts) bulbs, both employing standard efficiency ballasts.

1.3.2 ECO-1B: Fluorescent Fixture Retrofit in Building 220

This ECO utilizes the same technology as ECO-1A, however this ECO would reduce initial costs by utilizing the existing fixtures as much as possible. The use of a retrofit kit to convert existing T-12 fixtures to T-8 fixtures includes electronic ballasts, T-8 lamps, and reflectors applied to the existing fixtures. Again, the existing 8-foot fixtures are replaced by two 4-foot fixtures due to the unreliable nature of the 8-foot T-8 ballasts currently available on the market.

1.3.3 ECO-1C: Mercury Vapor Fixture Replacement in Building 220

This ECO evaluated the change out of the existing mercury vapor fixtures in high bay areas of Building 220. The existing fixtures provide light in the areas known as "the Craneway" and "Honing and NC Lathe Shop". In the Craneway the 1000 watt mercury vapor fixtures are replaced on a two-for-one basis by 1000 watt metal halide fixtures, providing more light than existing conditions. In the Lathe Shop, existing 400

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watt mercury vapors are replaced two-for-one with 400 watt metal halides, also providing more light output than existing conditions. Eight existing 750 watt mercury vapors located underneath the movable crane in the Lathe Shop are replaced one-for-one by 450 watt metal halide fixtures.

1.3.4 ECO-1D: Exit Sign Retrofits in Building 220

This ECO proposes to use a retrofit kit to convert existing 40 watt incandescent exit signs to 3 watt light-emitting diode (L. E. D.) fixtures. The retrofit kit provides for hard-wiring the L.E.D. fixtures in place so that a return to incandescent lamp usage is not possible. The L.E.D. has a minimum life expectancy of 25 years without maintenance.

1.3.5 ECO-2A: Fluorescent Fixture Replacements in Building 350 - Office Area

This ECO evaluated the feasibility of changing out all the existing 4-foot T-12 Fluorescent fixtures in Building 350 and replacing them with new 4-foot T-8 fluorescent fixtures utilizing high efficiency lamps, ballasts, and reflectors. The new system provides the same light output as the existing system in all areas, and in many cases provides more light than currently provided. This ECO provides a one-for-one fixture replacement, however the number of lamps has been reduced due to reflector usage. Unlike Building 220, the existing 4-foot fixtures in Building 350 were found to be mainly standard wattage lamps (40 watts each), thus the calculations for this ECO reflect a higher existing wattage per fixture than that of ECO-1A and ECO-1B.

1.3.6 ECO-2B: Installation of Occupancy Sensors in Building 350 - Office Area

ECO-2B was the installation of 250 occupancy sensors in the perimeter office areas of Building 350. The field survey revealed that approximately half of the office areas had lights left on by occupants after hours. Also, during working hours approximately one-

1 Executive Summary

half of the offices were unoccupied at any one time. Thus the on-time of lights in this area were assumed to be one-half of the baseline for the calculation of the ECO.

This ECO does not provide occupancy sensors in the core area offices. Due to the large number of sensors that would be required in these modular-style offices, the application was deemed infeasible.

1.3.7 ECO-2C: Fluorescent Fixture Replacements in Building 350 - Core Area

This ECO evaluated the feasibility of changing out all the existing 4- and 8-foot T-12 fluorescent fixtures in the core area of Building 350 and replacing them with new 4-foot T-8 fluorescent fixtures utilizing high efficiency lamps, ballasts, and reflectors. The new system provides the same light output as the existing system in all areas, and in many cases provides more light than existing fixtures. This ECO provides a one-for-one fixture replacement, however the number of lamps has been reduced due to reflector usage. The existing 8-foot fixtures are replaced by two 4-foot fixtures. As in ECO-2A, 40 watt lamps were observed in use, and were used in the baseline calculations.

This area was separated from the office area of Building 350 due to the different utilization times of the lights in the core and office areas. The lights in the core area were observed during the field survey to stay on 24 hours a day. The reason given for this was for security purposes. Therefore, in this ECO, the addition of 18 compact fluorescent fixtures in the core area was incorporated so that the existing lights could be shut off during unoccupied hours. The compact fluorescent fixtures will provide sufficient security lighting during off-hours.

1.3.8 ECO-2D: Incandescent Fixture Replacements in Building 350

ECO-2D involves replacing 277 incandescent fixtures with fluorescent fixtures throughout Building 350. A total of 193 lower-wattage fixtures will be replaced with

1 Executive Summary

compact fluorescent fixtures and eighty-four 200 and 300 watt fixtures are to be replaced by 4-foot T-8 fixtures. The bulk of the smaller-wattage fixtures are located in restrooms and stairwells, with a few located in recessed spotlight fixtures in conference rooms and offices. The 200 and 300 watt fixtures are all located in mechanical rooms where about half of the total were found to be on all day, and the other half, off all day.

1.3.9 ECO-2E: Exit Sign Retrofits in Building 350

This ECO proposes to use a retrofit kit to convert existing 40 watt incandescent exit signs to 3 watt light-emitting diode (L. E. D.) fixtures. The retrofit kit provides for hard-wiring the L.E.D. fixtures in place so that a return to incandescent lamp usage is not possible. The L.E.D. has a minimum life expectancy of 25 years without maintenance.

1.3.10 ECO-3A: Install 1 MW Peak-Shaving Plant at Building 160

ECO-3A evaluates the installation of a 1 MW natural gas/diesel engine-generator set to provide electrical demand peak-shaving capabilities for the Arsenal. The run time of the engine was determined from historical electrical demand profiles provided by the installation. The low amount of run time associated with the generator installation (about four hours per day, five days per week) provides for limited opportunities of heat recovery and utilization, and was deemed infeasible for this ECO. The annual maintenance cost used in the analysis was \$0.01 per kilowatthour of engine run time.

1.3.11 ECO-3B: Install 6 MW Peak-Shaving Plant at Building 160

ECO-3B was evaluated similarly to ECO-3A, however in this size generating equipment a natural gas/diesel turbine is more practical than a gas engine. The increased run time (about ten hours per day, five days per week) with this ECO allowed the consideration

1 Executive Summary

of heat recovery from the turbine. A heat recovery steam boiler package was chosen so that about 35,000 lbs/hr of 135 psig steam could be generated for injection into the Arsenal's central steam system. This requires making steam line tie-ins, water treatment, and handling of the condensate from the system, which was all included in the cost estimate.

1.3.12 ECO-3C: Install 24 MW Base Loaded Generating Plant at Building 160

This ECO was evaluated in the same manner as ECO-3B with the only difference being that ECO-3C provides for generating all the power that is currently purchased by the Arsenal by means of four 6 MW natural gas/diesel turbine-generators. The heat recovered from the turbine set is used to generate 110,000 lb/hr of 135 psig steam for use by the installation at the peak electrical demand of 24 MW.

Due to the size of the installation with four turbines, an alternative site to Building 160 was chosen. Building 168 (the old heating plant) was chosen since it is an open area building of 8,349 ft². This site will provide some investment savings for the project as some of the steam lines are still in place. As an alternative to this site, a new facility could be built next to the present heating plant.

In preparing the life cycle cost analysis for this ECO, a much cheaper gas rate was used. If this ECO was implemented, the Arsenal would most likely buy gas from a direct supplier due to the large quantities of gas involved. Thus a rate of \$3.00/MBTU was used in the analysis.

As mentioned previously, a maintenance savings of at least \$200,000 is anticipated by the Arsenal engineering staff due to the shutdown of the existing steam plant for three to four months during the summer. The heat recovered from the 24 MW cogeneration facility will provide more than enough steam to meet the Arsenal's needs during the summer.

Additionally, an investment savings of \$4 million is taken for this ECO since the proposed 24 MW facility will serve to provide backup power to Building 350. A

1 Executive Summary

detailed estimate for providing an emergency generator installation for Building 350 has been performed by DEH which indicated the cost to be over \$4 million for the required project. Thus, if the cogeneration facility is built, Building 350 has prime power supplied by the on-site turbine generators and emergency power provided by the existing Iowa and Illinois Electric Utility tie-in. Therefore, the investment cost used in the life cycle cost analysis for ECO-3C reflects a \$4 million credit in the first year.

It should be mentioned that the initial cost of ECO-3C (and ECO's 3A and 3B) could be significantly reduced even further by the use of surplus or reconditioned generators sets. However, this method of purchase is limited by the availability of the equipment (i.e.-a set of four 6 MW dual-fuel turbines may not be available on the surplus market at the time of construction).

1.4 ECIP PROJECTS DEVELOPED

As a result of the analysis, three Energy Conservation Investment Program (ECIP) Projects were developed. The three ECIP projects correspond to the three general ECO divisions:

- ECIP - 1: Lighting Improvements in Building 220
- ECIP - 2: Lighting Improvements in Building 350
- ECIP - 3: Cogeneration Installation at Building 168

Table 1.4.1 lists the pertinent data for each of the three ECIP Projects. ECIP-1 does not include ECO-1B even though it qualifies for ECIP funding because ECO-1A and ECO-1B accomplish the same work by different methods, and ECO-1A is the preferred alternative.

ECIP-3 was developed from ECO-3C: 24 MW Cogeneration System at Building 168.

No non-ECIP projects were developed from this study. No operational or policy changes are recommended as a result of this study.

Table 1.4.3 summarizes the energy savings for each ECIP project.

1 Executive Summary

TABLE 1.4.1 ECIP PROJECTS DEVELOPED					
BUILDING NUMBER	ECO NUMBER	INVESTMENT COST (\$)	ANNUAL SAVINGS (\$)	SIMPLE PAYBACK YEARS	SIR
220	1A	1,003,000	177,222	5.7	1.7
220	1C	59,000	21,723	2.7	2.5
220	1D	4,000	2,473	1.6	8.0
TOTAL ECIP - 1*	1A, 1C, 1D	1,066,000	201,418	5.3	2.1
350	2A	313,000	51,508	6.1	1.5
350	2B	27,000	3,366	8.0	1.7
350	2C	975,000	249,963	3.9	2.3
350	2D	43,000	8,312	5.2	2.5
350	2E	6,400	4,431	1.4	8.0
TOTAL ECIP - 2	2A - 2E	1,364,000	317,580	4.3	2.6
160	3C	16,199,000	2,844,423	5.7	1.0
TOTAL ECIP - 3	3C	16,199,000	2,844,423	5.7	1.0
TOTAL*	1A, 1C, 1D 2A - 2E, 3C	18,629,000	3,363,241	5.5	1.2

* TOTAL EXCLUDES ECO-1B SINCE ECO-1A WAS THE PREFERRED ALTERNATIVE.

1 Executive Summary

TABLE 1.4.2					
ROCK ISLAND ARSENAL LIMITED ENERGY STUDY					
SUMMARY OF ENERGY SAVINGS					
ECIP No.	BUILDING No.	CURRENT ENERGY (MBTU)	PROPOSED ENERGY (MBTU)	TOTAL ENERGY SAVINGS (MBTU)	% ENERGY REDUCTION
1	220	12,800 (ELEC.)	5240 (ELEC.)	7560	59.1
2	350	21,000 (ELEC.)	3600 (ELEC.)	17,400	82.9
3	168	1,839,000 (COAL & ELEC.)	2,242,000 (N.G.)	-403,000	-21.9

2 Work Accomplished to Date

The work which has been accomplished is summarized as follows:

1. Field Surveys completed for buildings 220, 350, and 160
2. Baseline Energy Consumption for 12 ECOs.
3. Evaluation of 12 Energy Conservation Opportunities.
4. Preparation and completion of all Field Notes.
5. Completion of Interim Report.
6. Completion of Final Report.
7. Preparation of Programming Document and 1391 forms.

This section of the report outlines the details of the work accomplished primarily through the use of a database which contains the information obtained in the field and developed from calculations. The data is presented in tables to provide specific information about each segment of the work accomplished to date.

2.1 FIELD SURVEY

The field survey as required in *Section 7, Scope of Work* has been completed. The survey was performed in the following two parts:

1. Lighting at Buildings 220 and 350.
2. Building 160 (Location of the proposed Cogeneration Equipment).

Table 2.1.1.1 provides a listing of the areas surveyed.

2.2 ENERGY CONSUMPTION BASELINE

The energy consumption baselines were established using computer calculation techniques as allowed by the scope of work. These calculation methods are discussed in detail under *Section 3.2, Calculations*.

2 Work Accomplished to Date

TABLE 2.1.1.1		
BUILDINGS SURVEYED		
BUILDING TYPE	BUILDING NUMBER	BUILDING AREA
Administrative	350	453,600
TOTAL AREA THIS TYPE		453,600
Machine Shop	220	536,970
TOTAL AREA THIS TYPE		536,970
Hydro Electric Plant	160	30,894
TOTAL AREA THIS TYPE		30,894
Old Steam Plant	168	8,349
TOTAL AREA THIS TYPE		8,349

2 Work Accomplished to Date

2.2.1 Lighting and Peak-Shaving/Cogeneration

The baseline energy consumption for Buildings 160, 220, and 350 was calculated using computerized techniques. The baselines were calculated using spreadsheets specifically designed for each energy conservation opportunity.

2.3 ENERGY CONSERVATION OPPORTUNITY CALCULATIONS

The energy conservation opportunity calculations were performed using computerized techniques. Spreadsheets were developed on LOTUS 123 for each ECO.

2.3.1 ECO-1A: Fluorescent Fixture Replacement in Building 220

This energy conservation opportunity was calculated using a LOTUS 123 spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.2 ECO-1B: Fluorescent Fixture Retrofit in Building 220

This ECO was calculated using a LOTUS 123 spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.3 ECO-1C: Mercury Vapor Fixture Replacement in Building 220

This energy conservation opportunity was calculated using a LOTUS 123 spreadsheet. Manufacturer's information and field notes were used in the calculations.

2 Work Accomplished to Date

2.3.4 ECO-1D: Exit Sign Retrofit in Building 220

This ECO was calculated using a LOTUS 123 spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.5 ECO-2A: Fluorescent Fixture Replacement in Building 350 - Office Area

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.6 ECO-2B: Occupancy Sensor Installation in Building 350 - Office Area

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.7 ECO-2C: Fluorescent Fixture Replacement in Building 350 - Core Area

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.8 ECO-2D: Incandescent Fixture Replacement in Building 350

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2 Work Accomplished to Date

2.3.9 ECO-2E: Exit Sign Retrofit in Building 350

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.10 ECO-3A: Install 1 MW Gas Engine Peak-Shaving Plant at Building 160

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.11 ECO-3B: Install 6 MW Gas Turbine Peak-Shaving Plant at Building 160

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.3.12 ECO-3C: Install 24 MW Gas Turbine Baseloaded Plant at Building 168

This energy conservation opportunity was calculated using a Lotus 123 Spreadsheet. Manufacturer's information and field notes were used in the calculations.

2.4 FIELD NOTES

The field notes which were taken during the site survey are included as an appendix in this project. (See *Appendix 12*)

3 Methods and Approach

This section of the report describes the method and approach which Systems Corp has used to accomplish the work completed to date. Of primary importance to the successful completion of a project of this magnitude is organization, planning and the ability to quickly document, evaluate and manipulate large amounts of data. This data must then be reduced to a usable form which allows the full development of the various projects within the available funding categories. The primary components of the work completed to date are as follows:

- Field Survey
- Energy Calculations
- Energy Conservation Opportunities Life Cycle Cost Estimates
- Review and Grouping of ECO's

Systems Corp has developed a methodology and approach to these tasks which result in a maximum benefit to the installation.

3.1 FIELD SURVEY

The field survey as performed by Systems Corp is designed to provide the necessary data required to complete the scope of work for this project. It is also designed to provide residual benefits to the installation by providing an organized and readily available source of information which can be used in future years.

The survey forms allow notations of all data which could be utilized (not necessarily required) to calculate the energy savings gained by implementing a specific energy conservation opportunity. These forms contain data obtained from as-built drawings and confirmed in the field as well as data obtained only in the field.

3.1.1 Lighting and Peak-Shaving/Cogeneration

Thorough preparation for the building survey is required to assure that the data required to perform the technical analysis is obtained. The building surveys were performed in a manner which assured the best results. A simple listing of each step of the process best describes our approach to the surveys.

3 Methods and Approach

1. The scope of work was reviewed in detail.
2. Each ECO was given an identification number which is used consistently throughout this project.
3. An expanded description of each ECO was formulated to outline the possible methods for implementation of the ECO.
4. A list of as-built drawings required for the buildings was prepared based on the information required on the ECO survey forms.
5. The building surveys were then performed, confirming or revising data obtained from the drawings. Additional data was obtained as required.
6. Systems Corp survey team met with the post Energy Officer throughout the survey on an as-needed basis.

3.2 CALCULATIONS

Energy calculations were performed using computerized techniques. Due to the large volume of calculations to be performed, standardized procedures were developed for the computer models. This assured consistent results and uniformity of quality in all of the calculations performed.

3.2.1 Baseline Energy Consumption

The following sections will describe the method for calculating the baseline energy consumption for each of the twelve (12) ECO options.

3 Methods and Approach

3.2.1.1 Baseline Energy Consumption: ECO-1A, 1B, 1C, and 1D

The baseline energy consumption for these ECOs was calculated using a LOTUS 123 spreadsheet. This spreadsheet modeled the energy consumption of the existing lighting systems in Building 220. The energy consumption was modeled using the following:

1. Existing lamp and fixture type
2. Lamp and ballast wattage
3. Hours of use.

Because the installation is subject to time-of-day electrical rates, the rate used in the calculations may change from ECO to ECO depending on the hours of utilization.

3.2.1.2 Baseline Energy Consumption: ECO-2A, 2B, 2C, 2D, and 2E

The baseline energy consumption for these ECOs was calculated using a LOTUS 123 spreadsheet. This spreadsheet modeled the energy consumption of the existing lighting system by utilizing the following:

1. Existing lamp and fixture type
2. Lamp and ballast wattage
3. Hours of use.

Because the installation is subject to time-of-day electrical rates, the rate used in the calculations may change from ECO to ECO depending on the hour of utilization. The baseline calculations for Building 350 use 40 watt fluorescent bulbs since this was the predominant bulb in use in the facility (rather than 34 watt tubes as in Building 220).

3 Methods and Approach

3.2.1.3 Baseline Energy Consumption: ECO-3A, 3B, and 3C

The baseline energy consumption for these ECOs was calculated using a LOTUS 123 spreadsheet. The energy consumption was modeled using manufacturer's data and historical utility consumption data provided by the installation. This spreadsheet modeled the electrical energy consumption of the Arsenal for all purchased electricity over a one year period.

3.2.2 ECO Energy Consumption

The followings sections describe how the energy consumption (or energy savings) for each of the twelve (12) ECOs was calculated.

3.2.2.1 ECO Energy Consumption: ECO-1A, 1B, 1C, and 1D

The energy consumption for these ECOs was calculated in the same manner as the baseline for ECO-1 (see *Section 3.2.1.1*). New lamp wattages, types, and quantities were substituted in the spreadsheet where the existing lighting system was evaluated.

3.2.2.2 ECO Energy Consumption: ECO-2A, 2B, 2C, 2D, and 2E

The energy consumption for these ECOs was calculated in the same manner as the baseline for ECO-2 (see *Section 3.2.1.2*). New lamp wattages, types, and quantities were substituted in the spreadsheet where the existing lighting system was evaluated.

3.2.2.3 ECO Energy Consumption: ECO-3A, 3B, and 3C

The energy consumption for these ECOs was calculated using a Lotus 123 spreadsheet. ECO 3A utilized a 1 MW natural gas engine-generator set for peak-shaving electrical generation; thus the ECO energy consumption for electricity was a reduction from that of the baseline, while the ECO energy consumption for natural gas increased from that of the baseline. ECOs 3B and 3C follow the same pattern while

3 Methods and Approach

varying the size and type of gas generators (turbine type, 6 and 24 MW, respectively). The costs of the displaced electricity varied depending on the strategy of the generating plant under evaluation, as the installation is subject to time-of-day electrical rates. Unlike the options evaluated in ECOs 1 and 2, the implementation of ECOs 3A, 3B, and 3C have considerable additional maintenance costs over the baseline which were also calculated on the same spreadsheet.

ECOs 3B and 3C also allowed for heat recovery devices which generate 135 psig steam for use in the Arsenal's central steam system. The spreadsheet was set up to show the savings from the heat recovery as dollars saved on coal, the fuel used at the central steam plant. Based on input from the Arsenal's engineering staff, an annual maintenance savings of \$200,000 was added to ECO-3C. This was due to the ability to essentially shut down the existing steam plant operations for 3 to 4 months each summer, since the 24 MW plant provides more than enough steam to meet the needs of the Arsenal at that time of year.

3.3 COST ESTIMATES

The cost estimates for the ECOs were obtained using a variety of sources. This section explains how each part of the cost estimate was determined.

The initial cost for each ECO is the sum of the construction costs for the project and the project costs. The construction cost includes all costs in materials, labor, and contractor's overhead and profit. The project costs include supervision, inspection and overhead (SIOH) for the project and the project design costs.

3.3.1 Construction Costs

The construction costs for each ECO were estimated using COMPOSER PLUS cost estimating software as required by the scope of work. Prices not available in the accompanying database were obtained using a combination of sources. These sources include the following:

- Local Vendors
- Systems Corp Estimating Data

3 Methods and Approach

All pricing has been adjusted where applicable to represent the labor costs in the Rock Island Arsenal labor market. The construction cost estimates have been prepared to include a reasonable level of detail for each ECO calculated.

3.3.2 Project Costs

The project costs for each ECO include the cost of supervision, inspection, and overhead required to complete the project. A value of 5.0% of the construction cost has been used for the SIOH. Also included in the project costs is the cost to design each ECO. The design cost has been included at a fixed value of 5.0% of construction cost. This approach assures that consistent values have been used for the project costs, allowing the combination of ECOs into larger projects without the need to adjust these values.

3.4 ECO LIFE CYCLE COSTS

The life cycle cost estimates for the ECOs are a combination of energy costs, investment costs, maintenance costs, and replacement costs. Each of these components may or may not be significant factors in determining the life cycle cost of the project. Each of these cost components have been evaluated for each ECO calculated in order to determine their contribution, if any, to the life cycle cost of the project.

The life cycle costs were calculated using the computer program Life Cycle Costing In Design (LCCID) as required in the scope of work.

3.4.1 Energy Costs

Energy costs for each type of fuel used in the facilities included in the scope of work were obtained from the Defense Energy Information System (DEIS) and utility data provided by the installation. Average energy costs per unit of fuel or unit of electricity were calculated.

3 Methods and Approach

3.4.1.1 Natural Gas Cost

The natural gas cost used for evaluating the ECOs is as follows:

$$\text{COST/MBTU} = \$4.17/\text{MBTU}$$

3.4.1.2 Coal Cost

The coal cost used for evaluating the ECOs is as follows:

$$\text{COST/MBTU} = \$2.01/\text{MBTU}$$

3.4.1.3 Electric Costs

The electric service cost used for evaluating the ECOs is as follows:

Billing Demand Charge

	Summer	Winter
All kW	\$10.55 per kW	\$5.75 per kW

Energy Charge

On Peak	All Kilowatthours	3.46¢ per kWh	3.46¢ per kWh
Off Peak	All Kilowatthours	2.14¢ per kWh	2.14¢ per kWh

Summer Applicable during the four monthly billing periods of June through September.

Winter Applicable during the eight monthly billing periods of October through May.

On Peak Hours Daytime periods between 8:00 a.m. and 8:00 p.m., Monday-Friday during the month excluding the United States legal holidays of New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas Day.

Off Peak Hours All hours not included in the definition of On Peak Hours.

3 Methods and Approach

3.4.2 Maintenance Costs

The maintenance and operating cost/savings for each ECO was calculated where applicable. We first considered whether the annual recurring (maintenance and operation) non-energy costs would significantly change as a result of each ECO. It is our belief that these values are sometimes unjustifiably manipulated to produce the desired results for the project economic analysis. Therefore, we most often assume that maintenance and operation activities will continue at the same rate as before the project. However, where there are readily identifiable differences such as increased lamp life for fluorescent lamps as compared to incandescent lamps, they have been included. The estimated costs were obtained from the Means Facilities Costs Data, 1988, and escalated to today's costs. Other sources included local service companies and Systems Corp developed data. These costs are shown on each life cycle summary sheet included in *Sections 5-8* of this report.

3.4.3 Replacement Costs

The replacement costs (non-energy non-annual recurring cost) for each ECO has been evaluated in the same manner as non-energy annual recurring costs. The same sources for cost data were used for estimating these costs also. Some examples of these types of cost items are as follows:

- lamp replacements
- ballasts replacements

It is the policy of Systems Corp to be conservative when estimating these more subjective cost components - which, if improperly evaluated, could result in inappropriate project qualification and funding decisions.

4 Recommended Projects and Organization

A considerable amount of data has been generated as a result of this study to date. Systems Corp has presented the data in four tables to provide the installation with different view points. The first table (*Table 4.1*) simply lists all of the ECOs ranked in descending order from highest to lowest SIR. This is the method which we are required to present in accordance with the scope of work. In addition, we have presented three other listings which should give the installation a clearer choice of projects.

The second listing is in *Table 4.2*. We have listed only those ECOs that we recommend you consider. Our criteria for this recommendation is: a SIR greater than 1.0 and a simple payback of ten (10) years or less, the project is recommended; if these two conditions are not met, the project is not recommended. On certain life cycle cost analyses, a statement "Project does not qualify for ECIP funding" will be shown. The buildings, if they meet the SIR and simple payback qualifications, are still listed since they will qualify when grouped with other buildings into projects.

The third listing is in *Table 4.3*. We have listed only those ECOs that we do not recommend for implementation. Again, the criteria used is simple. If the simple payback is greater than ten (10) years or SIR less than 1.0, the ECO is not recommended.

The fourth listing is in *Table 4.4*. This listing shows only the recommended ECO's and has them organized by building. This presentation allows you to clearly see the work required in each building if all ECOs are implemented. The listing also totals the investment costs and the annual cost savings. We have purposely provided only essential relevant information in these tables, omitting superfluous data. Other data is available in many locations throughout the body of the report.

Due to the relatively large investment cost of each of the three recommended ECOs, the projects are separated by building. The installation may, at their convenience, group any or all projects together simply by adding the three projects together. The similarity in construction type of ECOs 1 and 2 indicates that they could be easily bundled into one larger project if need be. However, due to the type of construction and large investment involved, ECO-3C is best left as a separate project.

4 Recommended Projects and Organization

The only mutually exclusive ECOs are ECO-1A and ECO-1B, which accomplish the same end by different means. Due to the small difference in payback and SIR of the two projects, Systems Corp has recommended ECO-1A over ECO-1B. ECO-1A provides for all new lighting fixtures in Building 220 rather than retrofitting existing fixtures as in ECO-1B.

4 Recommended Projects and Organization

TABLE 4.1			
ALL ECOs RANKED BY SIR			
ECO NUMBER	BUILDING NUMBER	ENERGY SAVINGS (MBTU-SOURCE)	S I R
1D	220	164	8.0
2E	350	291	8.0
IC	220	3424	2.5
2D	350	1062	2.3
2C	350	51225	2.1
1B	220	20054	1.6
2B	350	1109	1.5
1A	220	21724	1.4
2A	350	4432	1.3
3C	168	1275566	1.0
3A	160	-2349	0.5
3B	160	71550	0.1

4 Recommended Projects and Organization

TABLE 4.2 RECOMMENDED ECOs RANKED BY SIR			
ECO NUMBER	BUILDING NUMBER	ENERGY SAVINGS (MBTU) (SOURCE)**	SIR
1D	220	164	8.0
2E	350	291	8.0
1C	220	3424	2.5
2D	350	1062	2.3
2C	350	51225	2.1
1B	220	20054	1.6
2B	350	1109	1.5
1A	220	21724	1.4
2A	350	4432	1.3
3C	168	1275566	1.0

TOTALS* 1,379,051 MBTU 1.3 OVERALL SIR

*TOTAL EXCLUDES ECO-1B SINCE ECO-1A WAS THE PREFERRED ALTERNATIVE.

**SOURCE ELECTRICITY = SITE ELECTRICITY * 11,400/3,413

4 Recommended Projects and Organization

TABLE 4.3			
NON-RECOMMENDED ECOs RANKED BY SIR			
ECO NUMBER	BUILDING NUMBER	REASON FOR NOT RECOMMENDING	S I R
3A	160	SIR IS LESS THAN 1.0	0.5
3B	160	SIR IS LESS THAN 1.0	0.1

4 Recommended Projects and Organization

TABLE 4.4 RECOMMENDED ECOs BY BUILDING				
BUILDING NUMBER	ECO NUMBER	INVESTMENT COST (\$)	ANNUAL SAVINGS (\$)	SIMPLE PAYBACK YEARS
168	3C	16,199,000	2,844,423	5.7
TOTAL BUILDING 168	3C	16,199,000	2,844,423	5.7
220	1A	1,003,000	177,222	5.7
220	1B	739,000	147,001	5.0
220	1C	59,000	21,723	2.7
220	1D	4,000	2,473	1.6
TOTAL BUILDING 220*	1A, 1C, 1D	1,066,000	201,418	1.6
350	2A	313,000	51,508	6.1
350	2B	27,000	3,366	8.0
350	2C	975,000	249,963	3.9
350	2D	43,000	8,312	5.2
350	2E	6,400	4,431	1.4
TOTAL BUILDING 350	2A - 2E	1,364,000	317,580	4.3
TOTAL*	1A, 1C, 1D 2A - 2E, 3C	18,629,000	3,363,421	5.5

* TOTAL EXCLUDES ECO-1B SINCE ECO-1A WAS THE PREFERRED ALTERNATIVE.

4 Recommended Projects and Organization

TABLE 4.5 ROCK ISLAND ARSENAL LIMITED ENERGY STUDY SUMMARY OF ENERGY SAVINGS				
ECO NUMBER	BUILDING NUMBER	CURRENT ENERGY (MBTU-SITE)	PROPOSED ENERGY (MBTU-SITE)	TOTAL ENERGY SAVINGS (MBTU-SITE)
1A	220	10663	4159	6504
1B	220	10663	4659	6004
1C	220	2090	1065	1025
1D	220	52.6	3.6	49
2A	350	1991	664	1327
2B	350	664	332	332
2C	350	17383	2047	15336
2D	350	405.5	87.5	318
2E	350	94.4	7.4	87
3A	160	717549	728227	-10678
3B	160	824327	877716	-53389
3C	168	1838720	2242341	-403621

NOTE: SITE ELECTRIC ENERGY = SOURCE ELECTRIC ENERGY * 3,413/11,400

4 Recommended Projects and Organization

TABLE 4.6					
ROCK ISLAND ARSENAL LIMITED ENERGY STUDY					
SUMMARY OF COST ESTIMATES					
ECO NUMBER	BUILDING NUMBER	MATERIAL COST (\$)	LABOR COST (\$)	ADDITIONAL COST (\$)*	TOTAL COST ESTIMATE
1A	220	562,787	76,860	256,237	895,884
1B	220	138,083	331,916	189,784	659,783
1C	220	16,965	20,523	15,105	52,593
1D	220	1,617	726	941	3,284
2A	350	176,117	24,206	80,248	28,0571
2B	350	12,600	4,126	6,712	23,438
2C	350	547,898	75,941	249,906	873,745
2D	350	17,867	9,595	10,992	38,454
2E	350	2,903	1,304	1,690	5,897
3A	160	546,000	49,103	240,833	835,936
3B	160	3,525,000	177,826	1,067,784	4,770,610
3C	160	9,500,000	258,244	4,582,502	14,340,746

*INCLUDES SALES TAX, OVERHEAD, PROFIT, BOND, CONTINGENCIES, SIOH, AND DESIGN.

5 ECO - 1 Calculations

5.1 ECO-1A: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-1A -Fluorescent Fixture Replacement in Building 220.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO1A2

LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 001-A2 FLUORESCENT FIXTURE REPLACEMENT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	853223.		
B. SIOH	\$	42661.		
C. DESIGN COST	\$	42661.		
D. TOTAL COST (1A+1B+1C)	\$	938545.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				\$ 938545.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 9.90	6504.	\$ 64390.	8.08	\$ 520268.
B. DIST	\$.00	0.	\$ 0.	9.44	\$ 0.
C. RESID	\$.00	0.	\$ 0.	10.96	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	9.35	\$ 0.
E. COAL	\$.00	0.	\$ 0.	8.51	\$ 0.
F. PPG	\$.00	0.	\$ 0.	8.11	\$ 0.
M. DEMAND SAVINGS			\$ 29900.	8.11	\$ 242489.
N. TOTAL		6504.	\$ 94290.		\$ 762757.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ -1537.
(1) DISCOUNT FACTOR (TABLE A)	8.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ -12465.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPLACE	\$ 844691.	10	.68	574390.
d. TOTAL	\$ 844691.			574390.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2
PROJECT NO. & TITLE: 001-A2 FLUORESCENT FIXTURE REPLACEMENT
FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING
ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)\$ 561925.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 177222.
5. SIMPLE PAYBACK PERIOD (1G/4) 5.30 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1324682.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.41
(IF < 1 PROJECT DOES NOT QUALIFY)
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.65 %

11 OCTOBER 1993

ECO1A: BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING USE:
HOURS/DAY
DAYS/WEEK

<u>ELECTRIC COSTS:</u>	
ENERGY CHARGE	\$0.0338 PER KWH
DEMAND CHARGE	<u>\$7.35 PER KW</u>

EXISTING FIXTURE DATA

4 FOOT		
684 2 LAMP @	85 W/FXT =	56440 WATTS
0 2 LAMP @	100 W/FXT =	0 WATTS
148 2 LAMP @	288 W/FXT =	42624 WATTS
0 3 LAMP @	150 W/FXT =	0 WATTS
0 4 LAMP @	200 W/FXT =	0 WATTS
0 4 LAMP @	151.2 W/FXT =	0 WATTS

REPLACEMENT FIXTURE DATA

4 FOOT T8'S

684 1 LAMP W/ REFLECTORS	37 W/FDT =	24568 WATTS
		0 WATTS
148 2 LAMP W/ REFLECTORS	58 W/FDT =	8584 WATTS

8 FOOT

81 2 LAMP @	150 W/FXT =	9150 WATTS
1455 2 LAMP @	275 W/FXT =	400125 WATTS
89 2 LAMP @	538 W/FXT =	47882 WATTS

4 FOOT T8'S

122 1 LAMP W/ REFLECTORS	37 W/FXT =	4514 WATTS
3088 2 LAMP W/ REFLECTORS	58 W/FXT =	179104 WATTS

TOTAL EXISTING KW

556

TOTAL REPLACEMENT KW

217

NET ENERGY SAVINGS

6504 MBTU/YR

NET DOLLAR SAVINGS

\$94,317

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:14:31

FILE PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93
Current UPB/CSI ID: ORL290

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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
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Fri 01 Oct 1993

MAILED ESTIMATE

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:14:31

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT S
16500 LIGHTING										
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/	*** UNIT COSTS: ***			0.54	17.84	0.07	122.00	6.10	146.01
WC=1100	REFLECTOR	786.00 EA EELEB		425		14,025	55	95,892	4,795	114,766
CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/	*** UNIT COSTS: ***			0.59	19.42	0.08	136.00	6.80	162.29
WC=1100	REFLECTOR	3236.00 EA EELEB		1904		62,836	246	440,096	22,005	525,182
TOTAL DIVISION 16 ELECTRICAL					2328	76,860	300	535,988	26,799	639,948
TOTAL FACILITY AA. ELECTRICAL					2328	76,860	300	535,988	26,799	639,948
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					2328	76,860	300	535,988	26,799	639,948
TOTAL BASE BID					2328	76,860	300	535,988	26,799	639,948
TOTAL ADDITIVE					0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY					2328	76,860	300	535,988	26,799	639,948

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-1: LIGHTING IMPROVEMENTS BUILDING 220

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 220 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	639,948	63,995	0	52,796	18,918	0	775,657	775657.05
BID ITEM TOTAL		1.00 EA	639,948	63,995	0	52,796	18,918	0	775,657	775657.05

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

SUMMARY PAGE 3

ITEM AND FACILITY SUMMARY

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	639,948	63,995	0	52,796	18,918	0	775,657	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	639,948	63,995	0	52,796	18,918	0	775,657	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	775,657		775,657	775657.00
TOTAL CURRENT CONTRACT COST				775,657	0	775,657	
Cost Growth from 10/93 to 10/94							
	Index Values: 0000 0000	0.0%		0	0	0	
ESCALATED CONTRACT COST				775,657	0	775,657	
Government-Furnished Property				0		0	
SUBTOTAL				775,657	0	775,657	
Contingencies		10.0%		77,566	0	77,566	
SUBTOTAL				853,223	0	853,223	
SIOH (S&A)		5.0%		42,661	0	42,661	
CURRENT WORKING ESTIMATE				895,884	0	895,884	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

5-11

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	2328	76,860	300	562,787		639,948	100.0%	0	639,948
	TOTAL DIRECT				2328	76,860	300	562,787		639,948	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

TRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		639,948	63,995	10.0%	0.0		52,796	7.5%	2.5%	0.0%		775,657	100.0%		775657.04
	TOTAL OVERHEAD & PROFIT			63,995	10.0%			52,796	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	2328	76,860	300	535,988	26,799	639,948
TOTAL DIRECT	2328	76,860	300	535,988	26,799	639,948

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

5-14

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

ITEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	2328	76,860	300	535,988	26,799	639,948
TOTAL DIRECT	2328	76,860	300	535,988	26,799	639,948

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	ADJ FACTOR	ADJUSTD	BOOK OP	HRLY	UPB	TOTAL	COST
EMI20 SMALL TOOLS							1.40	1.40	214	300
TOTAL PROJECT EQUIPMENT HOURS									214	300

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1A: BLDG 220 FLUORESCENT FIXTURE CHANGEOUT

TIME 10:14:31

R SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	2328	76,860
TOTAL PROJECT MANHOURS								2328	76,860

* * * END OF SUMMARY REPORT * * *

5 ECO - 1 Calculations

5.2 ECO-1B: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-1B - Fluorescent Fixture Retrofit in Building 220.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO1B2

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.072

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 001-1B2 FLUORESCENT FIXTURE RETROFIT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	628364.		
B. SIOH	\$	31418.		
C. DESIGN COST	\$	31418.		
D. TOTAL COST (1A+1B+1C)	\$	691200.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				\$ 691200.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 9.90	6004.	\$ 59440.	8.08	\$ 480272.
B. DIST	\$.00	0.	\$ 0.	9.44	\$ 0.
C. RESID	\$.00	0.	\$ 0.	10.96	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	9.35	\$ 0.
E. COAL	\$.00	0.	\$ 0.	8.51	\$ 0.
F. PPG	\$.00	0.	\$ 0.	8.11	\$ 0.
M. DEMAND SAVINGS			\$ 27607.	8.11	\$ 223893.
N. TOTAL		6004.	\$ 87047.		\$ 704165.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)		\$ -2254.
(1) DISCOUNT FACTOR (TABLE A)	8.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ -18280.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-)	YR OC	DISCNT FACTR	DISCOUNTED SAVINGS (+) / COST (-) (4)
	(1)	(2)	(3)	
1. REPLACE	\$ 622080.	10	.68	423014.
d. TOTAL	\$ 622080.			423014.

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2
 PROJECT NO. & TITLE: 001-1B2 FLUORESCENT FIXTURE RETROFIT
 FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING
 ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

STUDY: ECO1B2

LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)\$ 404734.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 147001.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.70 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1108899.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.60
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.03 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 1 - LIGHTING IMPROVEMENTS IN BUILDING 220

11 OCTOBER 1993

ECO1B: BUILDING WIDE FLUORESCENT FIXTURE RETROFIT

BUILDING USE:
HOURS/DAY 18
DAYS/WEEK 6

ELECTRIC COSTS:
ENERGY CHARGE \$0.0338 PER KWH
DEMAND CHARGE \$7.35 PER KW

EXISTING FIXTURE DATA

4 FOOT
684 2 LAMP @ 85 W/FXT = 58440 WATTS
0 2 LAMP @ 100 W/FXT = 0 WATTS
148 2 LAMP @ 288 W/FXT = 42624 WATTS
0 3 LAMP @ 150 W/FXT = 0 WATTS
0 4 LAMP @ 200 W/FXT = 0 WATTS
0 4 LAMP @ 151.2 W/FXT = 0 WATTS

RETROFIT FIXTURE DATA

4 FOOT T8'S
684 2 LAMP 58 W/FXT = 38512 WATTS
0 WATTS
148 2 LAMP W/ 58 W/FXT = 8584 WATTS
REFLECTORS

8 FOOT
81 2 LAMP @ 150 W/FXT = 9150 WATTS
1455 2 LAMP @ 275 W/FXT = 400125 WATTS
89 2 LAMP @ 538 W/FXT = 47882 WATTS

4 FOOT T8'S
81 4 LAMP W/ 122 W/FXT = 7442 WATTS
REFLECTORS
1544 4 LAMP W/ 122 W/FXT = 188368 WATTS
REFLECTORS

TOTAL EXISTING KW 556 TOTAL REPLACEMENT KW 243

NET ENERGY SAVINGS 6004 MBTU/YR NET DOLLAR SAVINGS \$87,055

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:26:14

1 PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

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CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:26:14

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL

QUANTITY UOM CREW MANHR LABOR EQUIPMENT MATERIAL SALESTX DIRECT \$

16500 LIGHTING

16512 9210 1'X4' AND 2'X4' FIXTURE RETROFIT
 REPLACE EXISTING STANDARD EFFICIENCY LAMPS AND BALLASTS WITH 2 LAMP
 T8'S WITH ELECTRONIC BALLAST.

CD=3 EL 9211 1'X4' & 2'X4'	*** UNIT COSTS: ***	2.50	82.53	0.32	30.00	1.50	114.35
WC=1100	664.00 EA EELEB	1660	54,797	214	19,920	996	75,927
CD=3 EL 9212 1'X4' & 2'X4' W/ REFLECTORS	*** UNIT COSTS: ***	2.50	82.53	0.32	44.00	2.20	129.05
WC=1100	148.00 EA EELEB	370	12,214	48	6,512	326	19,099
CD=3 EL 9213 1'X8'	*** UNIT COSTS: ***	5.00	165.05	0.65	52.00	2.60	220.30
WC=1100	61.00 EA EELEB	305	10,068	39	3,172	159	13,438
CD=3 EL 9214 1'X8' HO & VHO	*** UNIT COSTS: ***	5.00	165.05	0.65	66.00	3.30	235.00
WC=1100	1544.00 EA EELEB	7720	254,837	996	101,904	5,095	362,832

TOTAL DIVISION 16 ELECTRICAL

10055 331,916 1,297 131,508 6,575 471,296

TOTAL FACILITY AA. ELECTRICAL

10055 331,916 1,297 131,508 6,575 471,296

TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE

10055 331,916 1,297 131,508 6,575 471,296

TOTAL BASE BID

10055 331,916 1,297 131,508 6,575 471,296

TOTAL ADDITIVE

0 0 0 0 0 0

TOTAL INCL ADD LIMITED ENERGY STUDY

10055 331,916 1,297 131,508 6,575 471,296

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-1: LIGHTING IMPROVEMENTS BUILDING 220

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 220 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	471,296	47,130	0	38,882	13,933	0	571,240	571240.27
BID ITEM TOTAL		1.00 EA	471,296	47,130	0	38,882	13,933	0	571,240	571240.27

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		471,296	47,130	0	38,882	13,933	0	571,240	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		471,296	47,130	0	38,882	13,933	0	571,240	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

5-27

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

JECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	571,240		571,240	571240.30
TOTAL CURRENT CONTRACT COST				571,240	0	571,240	
Cost Growth from 10/93 to 10/94							
	Index Values: 0000 0000	0.0%		0	0	0	
ESCALATED CONTRACT COST				571,240	0	571,240	
Government-Furnished Property				0		0	
SUBTOTAL				571,240	0	571,240	
Contingencies		10.0%		57,124	0	57,124	
SUBTOTAL				628,364	0	628,364	
SIOH (S&A)		5.0%		31,418	0	31,418	
CURRENT WORKING ESTIMATE				659,783	0	659,783	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

5-28

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	10055	331,916	1,297	138,083		471,296 100.0%	0	471,296
	TOTAL DIRECT				10055	331,916	1,297	138,083		471,296 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

5-29

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

TRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		471,296	47,130	10.0%	0.0	38,882	7.5%	2.5%	0.0%	571,240	100.0%	571240.26
	TOTAL OVERHEAD & PROFIT			47,130	10.0%		38,882	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

5-30

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	HANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	10055	331,916	1,297	131,508	6,575	471,296
TOTAL DIRECT	10055	331,916	1,297	131,508	6,575	471,296

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

5-31

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

EMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	10055	331,916	1,297	131,508	6,575	471,296
TOTAL DIRECT	10055	331,916	1,297	131,508	6,575	471,296

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1B

5-32

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY	UPB	***** TOTAL *****	
									RATE	RATE	HOURS	COST
ENI20 SMALL TOOLS									1.40	1.40	925	1,295
TOTAL PROJECT EQUIPMENT HOURS											925	1,295

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1B: BLDG 220 FLUORESCENT FIXTURE RETROFIT

TIME 12:26:14

SUMMARY PAGE 10

R SUMMARY

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	10055	331,916
TOTAL PROJECT MANHOURS								10055	331,916

* * * END OF SUMMARY REPORT * * *

5 ECO - 1 Calculations

5.3 ECO-1C: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-1C - Mercury Vapor Fixture Replacement in Building 220.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO1C1
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 001-C1 MERCURY VAPOR REPLACEMENT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-01-93 ECONOMIC LIFE 8 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	50088.		
B. SIOH	\$	2504.		
C. DESIGN COST	\$	2504.		
D. TOTAL COST (1A+1B+1C)	\$	55096.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			55096.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 9.90	1025.	\$ 10148.	6.69	\$ 67887.
B. DIST	\$.00	0.	\$ 0.	7.59	\$ 0.
C. RESID	\$.00	0.	\$ 0.	8.68	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	7.50	\$ 0.
E. COAL	\$.00	0.	\$ 0.	7.00	\$ 0.
F. PPG	\$.00	0.	\$ 0.	6.73	\$ 0.
M. DEMAND SAVINGS			\$ 4763.	6.73	\$ 32055.
N. TOTAL		1025.	\$ 14911.		\$ 99942.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ -75.
(1) DISCOUNT FACTOR (TABLE A)	6.73	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ -505.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPLACE	\$ 55096.	8	.73	40220.
d. TOTAL	\$ 55096.			40220.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2
PROJECT NO. & TITLE: 001-C1 MERCURY VAPOR REPLACEMENT
FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING
ANALYSIS DATE: 10-01-93 ECONOMIC LIFE 8 YEARS PREPARED BY: GREG LOFLIN

STUDY: ECO1C1

LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)\$ 39715.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 21723.
5. SIMPLE PAYBACK PERIOD (1G/4) 2.54 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 139657.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 2.53
(IF < 1 PROJECT DOES NOT QUALIFY)
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 16.82 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 1 - LIGHTING IMPROVEMENTS IN BUILDING 220

11 OCTOBER 1993

ECO1C: BUILDING WIDE MERCURY VAPOR REPLACEMENT

BUILDING USE:
HOURS/DAY 18
DAYS/WEEK 6

ELECTRIC COSTS:
ENERGY CHARGE \$0.0338 PER KWH
DEMAND CHARGE \$7.35 PER KW

EXISTING FIXTURE DATA

MERCURY VAPOR
96 1 LAMP @ 455 W/FXT = 43680 WATTS
8 2 LAMP @ 820 W/FXT = 8560 WATTS
54 2 LAMP @ 1080 W/FXT = 58320 WATTS

REPLACEMENT FIXTURE DATA

METAL HALIDE
56 1 LAMP W/ 460 W/FXT = 25760 WATTS
REFLECTORS
27 1 LAMP W/ 1085 W/FXT = 29295 WATTS
REFLECTORS

TOTAL EXISTING KW

109

TOTAL REPLACEMENT KW

55

NET ENERGY SAVINGS

1025 MBTU/YR

NET DOLLAR SAVINGS

\$14,866

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:35:37

LE PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

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CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C
5-39

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

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AA. ELECTRICAL.....	1

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

FILED ESTIMATE

DETAIL PAGE 1

1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT S
16500 LIGHTING									
16512 9100 METAL HALIDE FIXTURE W/ REFLECTOR, LAMP, AND BALLAST; LABOR INCLUDES REMOVAL OF 2 MERCURY VAPOR FIXTURES PER INSTALLATION.									
CD=3 EL 9101 1000 W	*** UNIT COSTS: ***			7.49	247.27	0.97	279.00	13.95	541.18
WC=1100	27.00 EA EELEB			202	6,676	26	7,533	377	14,612
CD=3 EL 9102 400 W	*** UNIT COSTS: ***			7.49	247.27	0.97	154.00	7.70	409.93
WC=1100	56.00 EA EELEB			419	13,847	54	8,624	431	22,956
TOTAL DIVISION 16 ELECTRICAL				622	20,523	80	16,157	808	37,568
TOTAL FACILITY AA. ELECTRICAL				622	20,523	80	16,157	808	37,568
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				622	20,523	80	16,157	808	37,568
TOTAL BASE BID				622	20,523	80	16,157	808	37,568
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY				622	20,523	80	16,157	808	37,568

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

SUMMARY PAGE 1

PROJECT NOTES

PROJECT NOTES

ECO-1: LIGHTING IMPROVEMENTS BUILDING 220

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 220 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-42

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	37,568	3,757	0	3,099	1,111	0	45,535	45534.91
BID ITEM TOTAL		1.00 EA	37,568	3,757	0	3,099	1,111	0	45,535	45534.91

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

SUMMARY PAGE 3

ITEM AND FACILITY SUMMARY

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		37,568	3,757	0	3,099	1,111	0	45,535	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		37,568	3,757	0	3,099	1,111	0	45,535	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-44

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

SUMMARY PAGE 4

ECT CWE SUMMARY

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	45,535		45,535	45534.90
	TOTAL CURRENT CONTRACT COST		45,535	0	45,535	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		45,535	0	45,535	
	Government-Furnished Property		0		0	
	SUBTOTAL		45,535	0	45,535	
	Contingencies	10.0%	4,553	0	4,553	
	SUBTOTAL		50,088	0	50,088	
	SIOH (S&A)	5.0%	2,504	0	2,504	
	CURRENT WORKING ESTIMATE		52,593	0	52,593	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-45

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	622	20,523	80	16,965	37,568	100.0%	0	37,568
	TOTAL DIRECT				622	20,523	80	16,965	37,568	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-46

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		37,568	3,757	10.0%	0.0	3,099	7.5%	2.5%	0.0%	45,535	100.0%	45534.91
	TOTAL OVERHEAD & PROFIT			3,757	10.0%		3,099	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-47

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	622	20,523	80	16,157	808	37,568
TOTAL DIRECT	622	20,523	80	16,157	808	37,568

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-48

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

ITEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	622	20,523	80	16,157	808	37,568
TOTAL DIRECT	622	20,523	80	16,157	808	37,568

CREW ID: OPL290

CURRENCY in DOLLARS

PROJECT ID: 220E1C

5-49

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

SUMMARY PAGE 9

----- *** BOOK VALUE ***		ADJ FACTOR		ADJUSTD		BOOK OP		--	HRLY	---	UPB	****	TOTAL	****
EQUIP	DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST	
EMI20	SMALL TOOLS									1.40	1.40	57	80	
												57	80	
TOTAL PROJECT EQUIPMENT HOURS														

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1C: BLDG 220 MERCURY VAPOR FIXT CHANGEOUT

TIME 10:35:37

DR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	622	20,523
TOTAL PROJECT MANHOURS								622	20,523

*** END OF SUMMARY REPORT ***

5 ECO - 1 Calculations

5.4 ECO-1D: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-1D - Exit Sign Retrofit in Building 220.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: EC01D
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 001-1D LED EXIT SIGNS

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-01-93 ECONOMIC LIFE 15 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	3128.	
B. SIOH	\$	156.	
C. DESIGN COST	\$	156.	
D. TOTAL COST (1A+1B+1C)	\$	3440.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		3440.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 8.20	49.	\$ 402.	11.19	\$ 4496.
B. DIST	\$.00	0.	\$ 0.	13.75	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.43	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	13.88	\$ 0.
E. COAL	\$.00	0.	\$ 0.	11.99	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 144.	11.12	\$ 1601.
N. TOTAL		49.	\$ 546.		\$ 6097.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	11.12	\$ 1927.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 21428.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 21428.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 2473.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.39 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 27526.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 8.00
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 19.47 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 1 - LIGHTING IMPROVEMENTS IN BUILDING 220
11 OCTOBER 1993

ECO 1D: EXIT SIGN RETROFIT - INCANDESCENT TO LED

# EXIT SIGNS	<u>44</u>	ELECTRIC COSTS:	
CURRENT WATTAGE	<u>40</u>	ENERGY CHARGE	<u>\$0.0280</u> PER KWH
REPLACEMENT WATTAGE	<u>3</u>	DEMAND CHARGE	<u>\$7.35</u> PER KW
HOURS/YEAR	<u>8760</u>		
BASELINE ENERGY CONSUMPTION	52.6		MBTU

NET ENERGY SAVINGS 48.6 MBTU/YR NET DOLLAR SAVINGS \$543

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 09:43:30

1 PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
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CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-55

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:43:30

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:43:30

MAILED ESTIMATE

DETAIL PAGE 1

1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING									
16530 1100 SURFACE OR PENDANT MOUNTED									
CD=3 EL 1119 LED PERMANENT RETROFIT KIT	*** UNIT COSTS: ***			0.50	16.51	0.06	35.00	1.75	53.32
WC=1100	44.00 EA EELEB			22	726	3	1,540	77	2,346
TOTAL DIVISION 16 ELECTRICAL				22	726	3	1,540	77	2,346
TOTAL FACILITY AA. ELECTRICAL				22	726	3	1,540	77	2,346
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				22	726	3	1,540	77	2,346
TOTAL BASE BID				22	726	3	1,540	77	2,346
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY				22	726	3	1,540	77	2,346

* * * END OF DETAIL REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-57

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:43:30

SUMMARY PAGE 1

PROJECT NOTES

PROJECT NOTES

ECO-1: LIGHTING IMPROVEMENTS BUILDING 220

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 220 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-58

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	2,346	10.0% 235	0.0% 0	7.5% 194	2.5% 69	0.0% 0	2,844	2843.57
BID ITEM TOTAL		1.00 EA	2,346	235	0	194	69	0	2,844	2843.57

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D
5-59

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-ID: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:43:30

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	2,346	235	0	194	69	0	2,844	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	2,346	235	0	194	69	0	2,844	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-60

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
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SUMMARY PAGE 4

PROJECT CWE SUMMARY

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
	1. BUILDING TO THE 5 FOOT LINE	1.00	EA	2,844		2,844	2843.60
	TOTAL CURRENT CONTRACT COST			2,844	0	2,844	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			2,844	0	2,844	
	Government-Furnished Property			0		0	
	SUBTOTAL			2,844	0	2,844	
	Contingencies	10.0%		284	0	284	
	SUBTOTAL			3,128	0	3,128	
	SIOH (S&A)	5.0%		156	0	156	
	CURRENT WORKING ESTIMATE			3,284	0	3,284	
	Estimated Construction Time	365	Days				

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-61

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:43:30

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	22	726	3	1,617		2,346 100.0%	0	2,346
	TOTAL DIRECT				22	726	3	1,617		2,346 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-62

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		2,346	235	10.0%	0.0	194	7.5%	2.5%	0.0%	2,844	100.0%	2843.57
	TOTAL OVERHEAD & PROFIT			235	10.0%		194	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-63

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-ID: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:43:30

SUMMARY PAGE 7

DIVISION SUMMARY

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	22	726	3	1,540	77	2,346
TOTAL DIRECT	22	726	3	1,540	77	2,346

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-64

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

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SUMMARY PAGE 8

ITEMS SUMMARY

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	22	726	3	1,540	77	2,346
TOTAL DIRECT	22	726	3	1,540	77	2,346

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D
5-65

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

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EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	2	3
TOTAL PROJECT EQUIPMENT HOURS										2	3

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 220E1D

5-66

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-1D: PERMANENT LED EXIT SIGN RETROFIT

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CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	**** TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	22	726
TOTAL PROJECT MANHOURS								22	726

* * * END OF SUMMARY REPORT * * *

6 ECO - 2 Calculations

6.1 ECO-2A: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-2A: Fluorescent Fixture Replacement in Building 350 - Office Area.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO2A2
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 002-A2 FLUORESCENT FIXTURE REPLACEMENT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	267210.		
B. SIOH	\$	13361.		
C. DESIGN COST	\$	13361.		
D. TOTAL COST (1A+1B+1C)	\$	293932.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			293932.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 9.90	1327.	\$ 13137.	8.08	\$ 106149.
B. DIST	\$.00	0.	\$ 0.	9.44	\$ 0.
C. RESID	\$.00	0.	\$ 0.	10.96	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	9.35	\$ 0.
E. COAL	\$.00	0.	\$ 0.	8.51	\$ 0.
F. PPG	\$.00	0.	\$ 0.	8.11	\$ 0.
M. DEMAND SAVINGS			\$ 11025.	8.11	\$ 89413.
N. TOTAL		1327.	\$ 24162.		\$ 195562.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	8.11	\$ 892.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 7234.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REPLACE	\$ 264539.	10	.68	179887.
d. TOTAL	\$ 264539.			179887.

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2
 PROJECT NO. & TITLE: 002-A2 FLUORESCENT FIXTURE REPLACEMENT
 FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING
 ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

STUDY: ECO2A2

LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)\$ 187121.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 51508.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.71 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 382683.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.30

(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.78 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 2 - LIGHTING IMPROVEMENTS IN BUILDING 350

11 OCTOBER 1993

ECO - 2A: OFFICE AREA FLUORESCENT FIXTURE REPLACEMENT

LIGHTING USAGE:

HOURS/DAY 12
DAYS/WEEK 5

ELECTRIC COSTS:

ENERGY CHARGE \$0.0338 PER KWH
DEMAND CHARGE \$7.35 PER KW

EXISTING FIXTURE DATA

4 FOOT T12'S
0.2 LAMP @ 85 W/FXT = 0 WATTS
609 2 LAMP @ 100 W/FXT = 60900 WATTS
0.2 LAMP @ 288 W/FXT = 0 WATTS
225 3 LAMP @ 150 W/FXT = 33750 WATTS
462 4 LAMP @ 200 W/FXT = 92400 WATTS

REPLACEMENT FIXTURE DATA

4 FOOT T8'S
609 1 LAMP W/ 37 W/FXT = 22533 WATTS
REFLECTORS
687 2 LAMP W/ 58 W/FXT = 39846 WATTS
REFLECTORS

8 FOOT T12'S
0.2 LAMP @ 150 W/FXT = 0 WATTS
0.2 LAMP @ 275 W/FXT = 0 WATTS
0.2 LAMP @ 538 W/FXT = 0 WATTS

4 FOOT T8'S

0.1 LAMP W/ 58 W/FXT = 0 WATTS
REFLECTORS

TOTAL EXISTING KW 187

TOTAL REPLACEMENT KW 62

NET ENERGY SAVINGS 1327 MBTU/YR

NET DOLLAR SAVINGS \$24,132

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 09:11:34

LE PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

6-5

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 01 Oct 1993

MAILED ESTIMATE

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:11:34

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING										
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/ REFLECTOR	*** UNIT COSTS: ***			0.54	17.84	0.07	122.00	6.10	146.01
WC=1100		609.00 EA EELEB		329		10,867	42	74,298	3,715	88,922
CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/ REFLECTOR	*** UNIT COSTS: ***			0.59	19.42	0.08	136.00	6.80	162.29
WC=1100		687.00 EA EELEB		404		13,340	52	93,432	4,672	111,496
TOTAL DIVISION 16 ELECTRICAL					733	24,206	95	167,730	8,387	200,418
TOTAL FACILITY AA. ELECTRICAL					733	24,206	95	167,730	8,387	200,418
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					733	24,206	95	167,730	8,387	200,418
TOTAL BASE BID					733	24,206	95	167,730	8,387	200,418
TOTAL ADDITIVE					0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY					733	24,206	95	167,730	8,387	200,418

*** END OF DETAIL REPORT ***

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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JECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-2: LIGHTING IMPROVEMENTS BUILDING 350

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 350 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

6-8

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	200,418	10.0% 20,042	0.0% 0	7.5% 16,534	2.5% 5,925	0.0% 0	242,919	242918.60
BID ITEM TOTAL		1.00 EA	200,418	20,042	0	16,534	5,925	0	242,919	242918.60

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		200,418	20,042	0	16,534	5,925	0	242,919	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		200,418	20,042	0	16,534	5,925	0	242,919	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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JECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	242,919		242,919	242918.60
	TOTAL CURRENT CONTRACT COST		242,919	0	242,919	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		242,919	0	242,919	
	Government-Furnished Property		0		0	
	SUBTOTAL		242,919	0	242,919	
	Contingencies	10.0%	24,292	0	24,292	
	SUBTOTAL		267,210	0	267,210	
	SIOH (S&A)	5.0%	13,361	0	13,361	
	CURRENT WORKING ESTIMATE		280,571	0	280,571	
	Estimated Construction Time	365 Days				

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

6-11

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	733	24,206	95	176,117		200,418	100.0%	0	200,418
	TOTAL DIRECT				733	24,206	95	176,117		200,418	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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TRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT PCT HOFC%	**** PROFIT **** AMOUNT PCT BOND% OTHR%	***** TOTAL CONTRACT ***** AMOUNT PCT UNIT COST
AA	GENERAL/PRIME		200,418	20,042 10.0% 0.0	16,534 7.5% 2.5% 0.0%	242,919 100.0% 242918.60
	TOTAL OVERHEAD & PROFIT			20,042 10.0%	16,534 7.5%	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

6-13

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	733	24,206	95	167,730	8,387	200,418
TOTAL DIRECT	733	24,206	95	167,730	8,387	200,418

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	733	24,206	95	167,730	8,387	200,418
TOTAL DIRECT	733	24,206	95	167,730	8,387	200,418

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2A

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	ADJ FACTOR	ADJUSTD	BOOK OP	-- HRLY	--- UPB	**** TOTAL ****		
				OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS								1.40	1.40	68	94
TOTAL PROJECT EQUIPMENT HOURS										68	94

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2A: OFFICE AREA FLUORESCENT FIXT REPLACENT

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SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	733	24,207
TOTAL PROJECT MANHOURS								733	24,207

* * * END OF SUMMARY REPORT * * *

6 ECO - 2 Calculations

6.2 ECO-2B: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-2B: Occupancy Sensor Installation in Building 350 - Office Area.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO2B
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 002-B OCCUPANCY SENSORS / BLDG 350 OFFICES

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	22322.		
B. SIOH	\$	1116.		
C. DESIGN COST	\$	1116.		
D. TOTAL COST (1A+1B+1C)	\$	24554.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			24554.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 10.14	332.	\$ 3366.	11.19	\$ 37671.
B. DIST	\$.00	0.	\$ 0.	13.75	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.43	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	13.88	\$ 0.
E. COAL	\$.00	0.	\$ 0.	11.99	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	11.12	\$ 0.
N. TOTAL		332.	\$ 3366.		\$ 37671.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.12		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 0.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 3366.

5. SIMPLE PAYBACK PERIOD (1G/4) 7.29 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 37671.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.53
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.01 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 2 - LIGHTING IMPROVEMENTS IN BUILDING 350

11 OCTOBER 1993

ECO-2A: OFFICE AREA FLUORESCENT FIXTURE REPLACEMENT

LIGHTING USAGE:		ELECTRIC COSTS:	
HOURS/DAY	12	ENERGY CHARGE	\$0.0338 PER KWH
DAYS/WEEK	5	DEMAND CHARGE	\$7.35 PER KW

EXISTING FIXTURE DATA

4 FOOT T12'S			
0 2 LAMP @	85 W/FXT =	0 WATTS	
609 2 LAMP @	100 W/FXT =	60900 WATTS	
0 2 LAMP @	288 W/FXT =	0 WATTS	
225 3 LAMP @	150 W/FXT =	33750 WATTS	
462 4 LAMP @	200 W/FXT =	92400 WATTS	

8 FOOT T12'S

0 2 LAMP @	150 W/FXT =	0 WATTS
0 2 LAMP @	275 W/FXT =	0 WATTS
0 2 LAMP @	538 W/FXT =	0 WATTS

TOTAL EXISTING KW 187

REPLACEMENT FIXTURE DATA

4 FOOT T8'S			
609 1 LAMP W/	REFLECTORS	37 W/FXT =	22533 WATTS
687 2 LAMP W/	REFLECTORS	58 W/FXT =	39846 WATTS

4 FOOT T8'S

0 1 LAMP W/	REFLECTORS	58 W/FXT =	0 WATTS
-------------	------------	------------	---------

TOTAL REPLACEMENT KW 62

NET ENERGY SAVINGS 1327 MBTU/YR

NET DOLLAR SAVINGS \$24,132

ECO-2B: OCCUPANCY SENSOR UTILIZATION AFTER LIGHTING RETROFIT IN OFFICE AREA

TOTAL KW	62 KW	ELECTRIC COSTS:
RUN TIME W/OCC SENSORS	6 HRS/DAY	ENERGY CHARGE
		\$0.0346 PER KWH
BASLINE ENERGY CONSUMPTION	664 MBTU	

NET ENERGY SAVINGS 332 MBTU/YR

NET DOLLAR SAVINGS \$3,367

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U.S. ARMY CORPS of ENGINEERS M-CACES

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LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-2B: OCCUPANCY SENSOR UTILITZATION AFTER 2A

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93
Current UPB/CSI ID: ORL290

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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2B: OCCUPANCY SENSOR UTILITZATION AFTER 2A

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DETAILED ESTIMATE

DETAIL PAGE

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2B: OCCUPANCY SENSOR UTILITIZATION AFTER 2A

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DETAIL PAGE 1

MAILED ESTIMATE

1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16900 CONTROLS AND INSTRUMENTATION									
16930 3000 OCCUPANCY SENSORS									
CD=3 EL 3001 OCCUPANCY SENSOR, 1800 W MAX	*** UNIT COSTS: ***			0.50	16.51	0.06	48.00	2.40	66.97
WC=1100	250.00 EA EELEB			125	4,126	16	12,000	600	16,742
TOTAL DIVISION 16 ELECTRICAL				125	4,126	16	12,000	600	16,742
TOTAL FACILITY AA. ELECTRICAL				125	4,126	16	12,000	600	16,742
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				125	4,126	16	12,000	600	16,742
TOTAL BASE BID				125	4,126	16	12,000	600	16,742
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY				125	4,126	16	12,000	600	16,742

* * * END OF DETAIL REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
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PROJECT NOTES

PROJECT NOTES

ECO-2: LIGHTING IMPROVEMENTS BUILDING 350

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 350 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2B: OCCUPANCY SENSOR UTILITIZATION AFTER 2A

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	16,742	10.0% 1,674	0.0% 0	7.5% 1,381	2.5% 495	0.0% 0	20,293	20292.81
BID ITEM TOTAL		1.00 EA	16,742	1,674	0	1,381	495	0	20,293	20292.81

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U.S. ARMY CORPS of ENGINEERS M-CACES
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SUMMARY PAGE 3

ITEM AND FACILITY SUMMARY

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		16,742	1,674	0	1,381	495	0	20,293	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		16,742	1,674	0	1,381	495	0	20,293	

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U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
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PROJECT CWE SUMMARY

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ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	20,293		20,293	20292.80
	TOTAL CURRENT CONTRACT COST			20,293	0	20,293	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			20,293	0	20,293	
	Government-Furnished Property			0		0	
	SUBTOTAL			20,293	0	20,293	
	Contingencies	10.0%		2,029	0	2,029	
	SUBTOTAL			22,322	0	22,322	
	SIOH (S&A)	5.0%		1,116	0	1,116	
	CURRENT WORKING ESTIMATE			23,438	0	23,438	
	Estimated Construction Time	365	Days				

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2B: OCCUPANCY SENSOR UTILITZATION AFTER 2A

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TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	125	4,126	16	12,600	16,742	100.0%	0	16,742
	TOTAL DIRECT				125	4,126	16	12,600	16,742	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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U.S. ARMY CORPS of ENGINEERS M-CACES
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TRACTOR INDIRECT SUMMARY

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ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		16,742	1,674	10.0%	0.0	1,381	7.5%	2.5%	0.0%	20,293	100.0%	20292.80
	TOTAL OVERHEAD & PROFIT			1,674	10.0%		1,381	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
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DIVISION SUMMARY

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	125	4,126	16	12,000	600	16,742
TOTAL DIRECT	125	4,126	16	12,000	600	16,742

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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U.S. ARMY CORPS of ENGINEERS M-CACES
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EMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	125	4,126	16	12,000	600	16,742
TOTAL DIRECT	125	4,126	16	12,000	600	16,742

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2B

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EQUIPMENT SUMMARY

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EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
ENI20 SMALL TOOLS								1.40	1.40	12	16
TOTAL PROJECT EQUIPMENT HOURS										12	16

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U.S. ARMY CORPS of ENGINEERS M-CACES
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OR SUMMARY

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CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	125	4,126
TOTAL PROJECT MANHOURS								125	4,126

* * * END OF SUMMARY REPORT * * *

6 ECO - 2 Calculations

6.3 ECO-2C: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-2C: Fluorescent Fixture Replacements in Building 350 - Core Area.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO2C2
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 002-C2 FLUORESCENT FIXTURE REPLACEMENT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	832138.	
B. SIOH	\$	41607.	
C. DESIGN COST	\$	41607.	
D. TOTAL COST (1A+1B+1C)	\$	915352.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		915352.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 8.20	15336.	\$ 125755.	8.08	\$ 1016102.
B. DIST	\$.00	0.	\$ 0.	9.44	\$ 0.
C. RESID	\$.00	0.	\$ 0.	10.96	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	9.35	\$ 0.
E. COAL	\$.00	0.	\$ 0.	8.51	\$ 0.
F. PPG	\$.00	0.	\$ 0.	8.11	\$ 0.
M. DEMAND SAVINGS			\$ 34222.	8.11	\$ 277540.
N. TOTAL		15336.	\$ 159977.		\$ 1293642.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A) 8.11

(2) DISCOUNTED SAVING/COST (3A X 3A1) \$ 7604.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPLACE	\$ 823817.	10	.68	560196.
d. TOTAL	\$ 823817.			560196.

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2
 PROJECT NO. & TITLE: 002-C2 FLUORESCENT FIXTURE REPLACEMENT
 FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING
 ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 10 YEARS PREPARED BY: GREG LOFLIN

STUDY: ECO2C2
 LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)\$ 621864.
 4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 249963.
 5. SIMPLE PAYBACK PERIOD (1G/4) 3.66 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1915506.
 7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 2.09
 (IF < 1 PROJECT DOES NOT QUALIFY)
 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 11.97 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 2 - LIGHTING IMPROVEMENTS IN BUILDING 350

11 OCTOBER 1993

ECO2C: CORE AREA FLUORESCENT FIXTURE REPLACEMENT

LIGHTING USAGE:

HOURS/DAY 24
DAYS/WEEK 7

ELECTRIC COSTS:

ENERGY CHARGE \$0.0280 PER KWH
DEMAND CHARGE \$7.35 PER KW

EXISTING FIXTURE DATA

4 FOOT
0 2 LAMP @ 85 W/FXT = 0 WATTS
1829 2 LAMP @ 100 W/FXT = 182900 WATTS
0 2 LAMP @ 288 W/FXT = 0 WATTS
873 3 LAMP @ 150 W/FXT = 100950 WATTS
1419 4 LAMP @ 200 W/FXT = 283800 WATTS

REPLACEMENT FIXTURE DATA

4 FOOT T8'S
1829 1 LAMP W/ REFLECTORS 37 W/FXT = 67673 WATTS
0 WATTS
2092 2 LAMP W/ REFLECTORS 58 W/FXT = 121336 WATTS

8 FOOT

100 2 LAMP @ 150 W/FXT = 15000 WATTS
0 2 LAMP @ 275 W/FXT = 0 WATTS
0 2 LAMP @ 538 W/FXT = 0 WATTS

4 FOOT T8'S

100 2 LAMP W/ REFLECTORS 58 W/FXT = 5800 WATTS

TOTAL EXISTING KW 583

COMPACT FLUORESCENTS

18 @ 26 W/FXT = 468 WATTS
TOTAL REPLACEMENT KW 195

NET ENERGY SAVINGS 15336 MBTU/YR

NET DOLLAR SAVINGS \$160,019

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

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LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93
Current UPB/CSI ID: ORL290

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CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C
6-38

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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DETAILED ESTIMATE

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U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 08:46:48

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL

QUANTITY UOM CREW MANHR LABOR EQUIPMENT MATERIAL SALESTX DIRECT \$

16500 LIGHTING

16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)

CD=3 EL 6107	SURF SQ W/1 26W BIAXIAL FL LAMP	*** UNIT COSTS: ***	1.25	41.26	0.00	31.00	1.55	73.81
WC=1100	WHITE ACRYLIC LENS	18.00 EA EELEA	23	743	0	558	28	1,329

16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST

CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/	*** UNIT COSTS: ***	0.54	17.84	0.07	122.00	6.10	146.01
WC=1100	REFLECTOR	1829.00 EA EELEB	989	32,635	128	223,138	11,157	267,058

CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/	*** UNIT COSTS: ***	0.59	19.42	0.08	136.00	6.80	162.29
WC=1100	REFLECTOR	2192.00 EA EELEB	1289	42,563	166	298,112	14,906	355,747

TOTAL DIVISION 16 ELECTRICAL

2301 75,941 294 521,808 26,090 624,134

TOTAL FACILITY AA. ELECTRICAL

2301 75,941 294 521,808 26,090 624,134

TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE

2301 75,941 294 521,808 26,090 624,134

TOTAL BASE BID

2301 75,941 294 521,808 26,090 624,134

TOTAL ADDITIVE

0 0 0 0 0 0

TOTAL INCL ADD LIMITED ENERGY STUDY

2301 75,941 294 521,808 26,090 624,134

*** END OF DETAIL REPORT ***

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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SUMMARY PAGE 1

PROJECT NOTES

PROJECT NOTES

ECO-2: LIGHTING IMPROVEMENTS BUILDING 350

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 350 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-41

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	624,134	62,413	0	51,491	18,451	0	756,489	756489.15
BID ITEM TOTAL		1.00 EA	624,134	62,413	0	51,491	18,451	0	756,489	756489.15

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

TIME 08:46:48

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		624,134	62,413	0	51,491	18,451	0	756,489	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		624,134	62,413	0	51,491	18,451	0	756,489	

Fri 01 Oct 1993

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TIME 08:46:48

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	756,489		756,489	756489.10
	TOTAL CURRENT CONTRACT COST		756,489	0	756,489	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		756,489	0	756,489	
	Government-Furnished Property		0		0	
	SUBTOTAL		756,489	0	756,489	
	Contingencies	10.0%	75,649	0	75,649	
	SUBTOTAL		832,138	0	832,138	
	SIOH (S&A)	5.0%	41,607	0	41,607	
	CURRENT WORKING ESTIMATE		873,745	0	873,745	

Estimated Construction Time

365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-44

Fri 01 Oct 1993

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TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	2301	75,941	294	547,898		624,134 100.0%	0	624,134
	TOTAL DIRECT				2301	75,941	294	547,898		624,134 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-45

Fri 01 Oct 1993

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ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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TRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		624,134	62,413	10.0%	0.0	51,491	7.5%	2.5%	0.0%	756,489	100.0%	756489.14
	TOTAL OVERHEAD & PROFIT			62,413	10.0%		51,491	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-46

Fri 01 Oct 1993

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ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

TIME 08:46:48

SUMMARY PAGE 7

DIVISION SUMMARY

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	2301	75,941	294	521,808	26,090	624,134
TOTAL DIRECT	2301	75,941	294	521,808	26,090	624,134

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-47

Fri 01 Oct 1993

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ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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ITEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	2301	75,941	294	521,808	26,090	624,134
TOTAL DIRECT	2301	75,941	294	521,808	26,090	624,134

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-48

Fri 01 Oct 1993

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ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNRSH	ADJ FACTOR	ADJUSTD	BOOK OP	-- HRLY	--- UPB	**** TOTAL ****	COST
EMI20 SMALL TOOLS								1.40	1.40	210	293
TOTAL PROJECT EQUIPMENT HOURS										210	293

Fri 01 Oct 1993

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ECO-2C: CORE AREA FLUORESCENT FIXT REPLACEMENT

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DR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	2301	75,941
TOTAL PROJECT MANHOURS								2301	75,941

* * * END OF SUMMARY REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2C

6-50

6 ECO - 2 Calculations

6.4 ECO-2D: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-2D: Incandescent Fixture Replacements in Building 350.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO2D
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 002-D INCANDESCENT LAMP REPLACEMENT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	36623.		
B. SIOH	\$	1831.		
C. DESIGN COST	\$	1831.		
D. TOTAL COST (1A+1B+1C)	\$	40285.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		40285.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 9.49	318.	\$ 3018.	11.19	\$ 33769.
B. DIST	\$.00	0.	\$ 0.	13.75	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.43	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	13.88	\$ 0.
E. COAL	\$.00	0.	\$ 0.	11.99	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 2638.	11.12	\$ 29335.
N. TOTAL		318.	\$ 5656.		\$ 63104.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 2656.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 29535.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 29535.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 8312.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.85 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 92639.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 2.30
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.94 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 2: LIGHTING IMPROVEMENTS IN BUILDING 350

11 OCTOBER 1993

ECO 2D: BUILDING WIDE INCANDESCENT LAMP REPLACEMENT

LAMP USE:

HOURS/DAY 12
DAYS/WEEK 5
PEAK USE 1 (1-YES, 2-NO)

ELECTRIC COSTS:

ENERGY CHARGE \$0.0324 PER KWH
DEMAND CHARGE \$7.35 PER KW

EXISTING INCANDESCENTS

20 LAMPS @ 52 WATTS = 1040 WATTS
102 LAMPS @ 60 WATTS = 6120 WATTS
14 LAMPS @ 75 WATTS = 1050 WATTS
41 LAMPS @ 90 WATTS = 3690 WATTS
16 LAMPS @ 100 WATTS = 1600 WATTS
6 LAMPS @ 200 WATTS = 1200 WATTS
78 LAMPS @ 300 WATTS = 23400 WATTS

COMPACT FLUORESCENT REPLACEMENT

122 LAMPS @ 13 WATTS = 1586 WATTS
14 LAMPS @ 18 WATTS = 252 WATTS
57 LAMPS @ 26 WATTS = 1482 WATTS
4 FOOT T8 REPLACEMENT
84 2 LAMPS W/ REFLECTOR 58 WATTS = 4872 WATTS

TOTAL EXISTING WATTS 38100

TOTAL REPLACEMENT WATTS 8192

BASELINE ENERGY CONSUMPTION 405.5 MBTU

REPLACEMENT ENERGY CONSUMPTION 87.2 MBTU

NET ENERGY SAVINGS 318 MBTU/YR

NET DOLLAR SAVINGS \$5,661

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:01:16

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LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

6-54

Fri 01 Oct 1993

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LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

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1. BUILDING TO THE 5 FOOT LINE	
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LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL

ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

DETAIL PAGE 1

MAILED ESTIMATE

1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING										
16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)										
CD=3 EL 6105	SURF SQ W/1 13W BIAXIAL FL LAMP	***	UNIT COSTS: ***	1.25	41.26	0.00	27.80	1.39	70.45	
WC=1100	WHITE ACRYLIC LENS	122.00	EA EELEA	153	5,034	0	3,392	170	8,595	
CD=3 EL 6106	SURF SQ W/1 18W BIAXIAL FL LAMP	***	UNIT COSTS: ***	1.25	41.26	0.00	31.00	1.55	73.81	
WC=1100	WHITE ACRYLIC LENS	14.00	EA EELEA	18	578	0	434	22	1,033	
CD=3 EL 6107	SURF SQ W/1 26W BIAXIAL FL LAMP	***	UNIT COSTS: ***	1.25	41.26	0.00	31.00	1.55	73.81	
WC=1100	WHITE ACRYLIC LENS	57.00	EA EELEA	71	2,352	0	1,767	88	4,207	
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/	***	UNIT COSTS: ***	0.59	19.42	0.08	136.00	6.80	162.29	
WC=1100	REFLECTOR	84.00	EA EELEB	49	1,631	6	11,424	571	13,633	
TOTAL DIVISION 16 ELECTRICAL					291	9,595	6	17,017	851	27,469
TOTAL FACILITY AA. ELECTRICAL					291	9,595	6	17,017	851	27,469
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					291	9,595	6	17,017	851	27,469
TOTAL BASE BID					291	9,595	6	17,017	851	27,469
TOTAL ADDITIVE					0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY					291	9,595	6	17,017	851	27,469

* * * END OF DETAIL REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

TIME 10:01:16

SUMMARY PAGE 1

PROJECT NOTES

PROJECT NOTES

ECO-2: LIGHTING IMPROVEMENTS BUILDING 350

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 350 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

6-57

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
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ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

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SUMMARY PAGE 2

ITEM AND FACILITY SUMMARY

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	27,469	10.0% 2,747	0.0% 0	7.5% 2,266	2.5% 812	0.0% 0	33,294	33293.61
BID ITEM TOTAL		1.00 EA	27,469	2,747	0	2,266	812	0	33,294	33293.61

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

6-58

Fri 01 Oct 1993

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SUMMARY PAGE 3

ITEM AND FACILITY SUMMARY

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
----	----------	-------------	----------	----------	--------	------	------------	------------	-----------

TOTAL BASE BID		27,469	2,747	0	2,266	812	0	33,294	
----------------	--	--------	-------	---	-------	-----	---	--------	--

TOTAL ADDITIVE		0	0	0	0	0	0	0	
----------------	--	---	---	---	---	---	---	---	--

TOTAL INCL ADD		27,469	2,747	0	2,266	812	0	33,294	
----------------	--	--------	-------	---	-------	-----	---	--------	--

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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Fri 01 Oct 1993

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 ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

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PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	33,294		33,294	33293.60
	TOTAL CURRENT CONTRACT COST		33,294	0	33,294	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		33,294	0	33,294	
	Government-Furnished Property		0		0	
	SUBTOTAL		33,294	0	33,294	
	Contingencies	10.0%	3,329	0	3,329	
	SUBTOTAL		36,623	0	36,623	
	SIOH (S&A)	5.0%	1,831	0	1,831	
	CURRENT WORKING ESTIMATE		38,454	0	38,454	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	291	9,595	6	17,867		27,469 100.0%	0	27,469
	TOTAL DIRECT				291	9,595	6	17,867		27,469 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		27,469	2,747	10.0%	0.0	2,266	7.5%	2.5%	0.0%	33,294	100.0%	33293.60
	TOTAL OVERHEAD & PROFIT			2,747	10.0%		2,266	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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Fri 01 Oct 1993

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DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	291	9,595	6	17,017	851	27,469
TOTAL DIRECT	291	9,595	6	17,017	851	27,469

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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Fri 01 Oct 1993

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SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	291	9,595	6	17,017	851	27,469
TOTAL DIRECT	291	9,595	6	17,017	851	27,469

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

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Fri 01 Oct 1993

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ECO-2D: BUILDING WIDE INCANDESCENT REPLACEMENT

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EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE ***		ADJ FACTOR		ADJUSTD		BOOK OP --		HRLY	---	UPB	****	TOTAL	****
EQUIP	DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20	SMALL TOOLS									1.40	1.40	5	6
												5	6
TOTAL PROJECT EQUIPMENT HOURS													

Fri 01 Oct 1993

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OR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	291	9,594
TOTAL PROJECT MANHOURS								291	9,594

*** END OF SUMMARY REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2D

6-66

6 ECO - 2 Calculations

6.5 ECO-2E: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimates for ECO-2E: Exit Sign Retrofits in Building 350.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO2E
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 002-E EXIT SIGN RETROFIT

FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	5616.	
B. SIOH	\$	281.	
C. DESIGN COST	\$	281.	
D. TOTAL COST (1A+1B+1C)	\$	6178.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		6178.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 8.20	87.	\$ 713.	11.19	\$ 7983.
B. DIST	\$.00	0.	\$ 0.	13.75	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.43	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	13.88	\$ 0.
E. COAL	\$.00	0.	\$ 0.	11.99	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 258.	11.12	\$ 2869.
N. TOTAL		87.	\$ 971.		\$ 10852.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 3460.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 38475.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
------	------------------------------	-----------------	------------------------	--

d. TOTAL \$ 0. 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 38475.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 4431.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.39 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 49327.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 7.98
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 19.45 %

ROCK ISLAND ARSENAL LIMITED ENERGY STUDY

ECO 2 - LIGHTING IMPROVEMENTS IN BUILDING 350
11 OCTOBER 1993

ECO 2E: EXIT SIGN RETROFIT - INCANDESCENT TO LED

# EXIT SIGNS	<u>79</u>	ELECTRIC COSTS:	
CURRENT WATTAGE	<u>40</u>	ENERGY CHARGE	<u>\$0.0280</u> PER KWH
REPLACEMENT WATTAGE	<u>3</u>	DEMAND CHARGE	<u>\$7.35</u> PER KW
HOURS/YEAR	<u>8760</u>		

BASELINE ENERGY CONSUMPTION 94.4 MBTU

NET ENERGY SAVINGS 87.3 MBTU/YR NET DOLLAR SAVINGS \$975

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 09:19:06

() PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93
Current UPB/CSI ID: ORL290

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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E
6-70

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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DETAILED ESTIMATE	DETAIL PAGE
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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-2E: PERMANENT LED EXIT SIGN RETROFIT
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:19:06

MAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING									
16530 1100 SURFACE OR PENDANT MOUNTED									
CD=3 EL 1119 LED PERMANENT RETROFIT KIT	*** UNIT COSTS: ***			0.50	16.51	0.06	35.00	1.75	53.32
WC=1100	79.00 EA EELEB			40	1,304	5	2,765	138	4,212
TOTAL DIVISION 16 ELECTRICAL				40	1,304	5	2,765	138	4,212
TOTAL FACILITY AA. ELECTRICAL				40	1,304	5	2,765	138	4,212
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				40	1,304	5	2,765	138	4,212
TOTAL BASE BID				40	1,304	5	2,765	138	4,212
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY				40	1,304	5	2,765	138	4,212

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-72

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:19:06

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-2: LIGHTING IMPROVEMENTS BUILDING 350

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY LIGHTING IN BUILDING 350 TO
SAVE ELECTRICAL ENERGY AND DEMAND.

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

TIME 09:19:06

SUMMARY PAGE 2

ITEM AND FACILITY SUMMARY

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR	FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%			
		1.00 EA	4,212	421	0	348	125	0		5,105	5105.50
BID ITEM TOTAL		1.00 EA	4,212	421	0	348	125	0		5,105	5105.50

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-74

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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SUMMARY PAGE 3

ITEM AND FACILITY SUMMARY

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	4,212	421	0	348	125	0	5,105	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	4,212	421	0	348	125	0	5,105	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-75

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
	1. BUILDING TO THE 5 FOOT LINE	1.00 EA	5,106		5,106	5105.50
	TOTAL CURRENT CONTRACT COST		5,106	0	5,106	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		5,106	0	5,106	
	Government-Furnished Property		0		0	
	SUBTOTAL		5,106	0	5,106	
	Contingencies	10.0%	511	0	511	
	SUBTOTAL		5,616	0	5,616	
	SIOH (S&A)	5.0%	281	0	281	
	CURRENT WORKING ESTIMATE		5,897	0	5,897	
	Estimated Construction Time	365 Days				

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-76

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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TRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	** SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	40	1,304	5	2,903		4,212 100.0%	0	4,212
	TOTAL DIRECT				40	1,304	5	2,903		4,212 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-77

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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TRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT PCT	HOFC%	**** PROFIT **** AMOUNT PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT PCT	UNIT COST
AA	GENERAL/PRIME		4,212	421 10.0%	0.0	348 7.5%	2.5%	0.0%	5,105 100.0%	5105.50
	TOTAL OVERHEAD & PROFIT			421 10.0%		348 7.5%				

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-78

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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SUMMARY PAGE 7

DIVISION SUMMARY

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	40	1,304	5	2,765	138	4,212
TOTAL DIRECT	40	1,304	5	2,765	138	4,212

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-79

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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ITEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	40	1,304	5	2,765	138	4,212
TOTAL DIRECT	40	1,304	5	2,765	138	4,212

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E

6-80

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	4	5
TOTAL PROJECT EQUIPMENT HOURS										4	5

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-2E: PERMANENT LED EXIT SIGN RETROFIT

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FOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	40	1,304
TOTAL PROJECT MANHOURS								40	1,304

* * * END OF SUMMARY REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 350E2E
6-82

7 ECO - 3 Calculations

7.1 ECO-3A: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimate for ECO-3A: Install 1 MW Peak-Shaving Generator at Building 160.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO3A
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND ARREGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 003-A 1MW GENERATOR

FISCAL YEAR 1994 DISCRETE PORTION NAME: GENERATOR

ANALYSIS DATE: 10-02-93 ECONOMIC LIFE 20 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	796130.	
B. SIOH	\$	39806.	
C. DESIGN COST	\$	39806.	
D. TOTAL COST (1A+1B+1C)	\$	875742.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		875742.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 10.14	3559.	\$ 36088.	13.81	\$ 498379.
B. DIST	\$.00	0.	\$ 0.	17.57	\$ 0.
C. RESID	\$.00	0.	\$ 0.	21.40	\$ 0.
D. NAT G	\$ 4.17	-14237.	\$ -59368.	18.18	\$ -1079316.
E. COAL	\$.00	0.	\$ 0.	15.15	\$ 0.
F. PPG	\$.00	0.	\$ 0.	13.59	\$ 0.
M. DEMAND SAVINGS			\$ 88200.	13.59	\$ 1198638.
N. TOTAL		-10678.	\$ 64920.		\$ 617701.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ -10429.
(1) DISCOUNT FACTOR (TABLE A)	13.59	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ -141730.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
------	------------------------------	-----------------	------------------------	--

d. TOTAL	\$	0.		0.
----------	----	----	--	----

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ -141730.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 54491.

5. SIMPLE PAYBACK PERIOD (1G/4) 16.07 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 475971.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= .54
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): .88 %

ROCK ISLAND ARSENAL ECO#3 - GAS TURBINE GENERATOR ECO 3A: 1 MW PEAK-SHAVING PLANT

BASELINE CALCULATIONS:

DAYS	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
MWH(purchased)	7756	6482	7798	7798	8232	8442	10394	8008	8064	7308	7182	7952
\$/MWH	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
KW(purchased)	18472	16594	17476	18144	18862	18887	19152	19228	19328	17136	17539	18358
\$/KW	5.75	5.75	5.75	5.75	5.75	10.55	10.55	10.55	10.55	5.75	5.75	5.75
TOTAL \$	331914	284042	327409	331250	348008	444920	504519	435888	438573	311195	309845	336962

ECO CALCULATIONS:

RUN HOURS	89	80	89	86	89	86	89	89	86	89	86	89
MWH(turbine)	89	80	89	86	89	86	89	89	86	89	86	89
MWH(purchased)	7667	6402	7709	7712	8143	8356	10305	7919	7978	7219	7096	7863
MW(turbine)	1	1	1	1	1	1	1	1	1	1	1	1
KW(purchased)	17472	15594	16476	17144	17862	17887	18152	18228	18328	16136	16539	17358
ENERGY SAVINGS (\$)	3065	2768	3065	2966	3065	2966	3065	3065	2966	3065	2966	3065
DEMAND SAVINGS (\$)	5750	5750	5750	5750	5750	10550	10550	10550	10550	5750	5750	5750
CCF NAT GAS	12092	10922	12092	11702	12092	11702	12092	12092	11702	12092	11702	12092
\$/CCF	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417
TURBINE MAINT	886	800	886	857	886	857	886	886	857	886	857	886
\$ SAVINGS	3772	3964	3772	3836	3772	8636	8572	8572	8636	3772	3836	3772

ANNUAL ENERGY SAVINGS (MBTU) = 3559

ANNUAL ENERGY SAVINGS (\$) = 64914

ANNUAL MAINTENANCE (\$) = 10429

NET ANNUAL SAVINGS (\$) = 54486

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 14:15:02

LE PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

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CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

7-4

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
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U.S. ARMY CORPS of ENGINEERS H-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-3A: 1 MW GAS TURBINE GENERATOR SET
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 14:15:02

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16200 POWER GENERATION										
16211 6000 NAT GAS ENGINE GENERATOR SET RATED FOR										
CONTINUOUS DUTY, INCLUDING LUBE SYSTEM, COOLING SYSTEM, AND CONTROL										
PACKAGE										
CD=3 EL 6001	1 MW	*** UNIT COSTS: ***			661	21823.40	899.40	500000.00	25000	547722.80
WC=1100		1.00 EA EELEH			661	21,823	899	500,000	25,000	547,723
CD=3 EL 6002	1 MW	*** UNIT COSTS: ***			661	21823.40	899.40	0.00	0.00	22722.80
WC=1100		1.00 EA EELEH			661	21,823	899	0	0	22,723
16400 SERVICE AND DISTRIBUTION										
16460 2000 SWITCHGEAR, KVA PAD MTD, TRANSFORMER, LIGHTNING										
ARRESTORS, FUSED LOAD INTERRUPTER SWITCH, SAFETY SWITCHES, AND PANEL										
BOARD										
CD=3 EL 2004	1000 KVA	*** UNIT COSTS: ***			165	5455.85	224.85	20000.00	1000	26680.70
WC=1100		1.00 EA EELEH			165	5,456	225	20,000	1,000	26,681
TOTAL DIVISION 16 ELECTRICAL					1487	49,103	2,024	520,000	26,000	597,126
TOTAL FACILITY AA. ELECTRICAL					1487	49,103	2,024	520,000	26,000	597,126
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					1487	49,103	2,024	520,000	26,000	597,126
TOTAL BASE BID					1487	49,103	2,024	520,000	26,000	597,126
TOTAL ADDITIVE					0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY					1487	49,103	2,024	520,000	26,000	597,126

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

7-6

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

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PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-3: PEAK SHAVING / COGENERATION

SCOPE OF WORK: EVALUATE USE OF GENERATORS FOR PEAK SHAVING AND/OR
COGENERATION TO SAVE ELECTRICAL DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

7-7

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

SUMMARY PAGE 2

ITEM AND FACILITY SUMMARY

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR	FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%			
		1.00 EA	597,126	59,713	0	49,263	17,653	0		723,754	723754.40
BID ITEM TOTAL		1.00 EA	597,126	59,713	0	49,263	17,653	0		723,754	723754.40

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	597,126	59,713	0	49,263	17,653	0	723,754	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	597,126	59,713	0	49,263	17,653	0	723,754	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

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Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	723,754		723,754	723754.40
	TOTAL CURRENT CONTRACT COST		723,754	0	723,754	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		723,754	0	723,754	
	Government-Furnished Property		0		0	
	SUBTOTAL		723,754	0	723,754	
	Contingencies	10.0%	72,375	0	72,375	
	SUBTOTAL		796,130	0	796,130	
	SIOH (S&A)	5.0%	39,806	0	39,806	
	CURRENT WORKING ESTIMATE		835,936	0	835,936	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

7-10

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

SUMMARY PAGE 5

TRACTOR DIRECT SUMMARY

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	** TOTAL DIRECT * AMOUNT PCT	** SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	1487	49,103	2,024	546,000	597,126 100.0%	0	597,126
	TOTAL DIRECT				1487	49,103	2,024	546,000	597,126 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

7-11

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

TRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

-----		*** OVERHEAD ***	-----		**** PROFIT ****	-----		***** TOTAL CONTRACT *****					
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHER%	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		597,126	59,713	10.0%	0.0	49,263	7.5%	2.5%	0.0%	723,754	100.0%	723754.40
				-----			-----						
				59,713	10.0%		49,263	7.5%					
			TOTAL OVERHEAD & PROFIT										

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA
7-12

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	1487	49,103	2,024	520,000	26,000	597,126
TOTAL DIRECT	1487	49,103	2,024	520,000	26,000	597,126

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA

7-13

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

SUMMARY PAGE 8

EMS SUMMARY

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	1487	49,103	2,024	520,000	26,000	597,126
TOTAL DIRECT	1487	49,103	2,024	520,000	26,000	597,126

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGA
7-14

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

TIME 14:15:02

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EQUIP DESCRIPTION		LIFE HRS	TL	HRLY	OWNRSH	ADJ FACTOR	ADJUSTD	BOOK OP	--	HRLY	---	UPB	****	TOTAL	****
						OWNS	OVTM	OWNRSH	EXPENSE	RATE		RATE	HOURS		COST
ECR40	CRANE, 40 TON, TRUCK MTD. (3665)									38.93		38.93	47	1,822	
EMI20	SMALL TOOLS									1.40		1.40	144	202	
													191	2,024	
TOTAL PROJECT EQUIPMENT HOURS															

Fri 01 Oct 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3A: 1 MW GAS TURBINE GENERATOR SET

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SUMMARY PAGE 10

OR SUMMARY

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	1440	47,570
LOEHO	EQ OPER, CRANE/SHOVL	21.40	0.0%	24.0%	6.20	0.00	32.74	24.39	47	1,532
									1487	49,103
TOTAL PROJECT MANHOURS										

* * * END OF SUMMARY REPORT * * *

7 ECO - 3 Calculations

7.2 ECO-3B: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimate for ECO-3B: Install 6 MW Peak-Shaving Plant at Building 160.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO3B
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: ROCK ISLAND REGION NOS. 5 CENSUS: 2

PROJECT NO. & TITLE: 003-B 6MW GENERATOR

FISCAL YEAR 1994 DISCRETE PORTION NAME: GENERATOR

ANALYSIS DATE: 10-06-93 ECONOMIC LIFE 20 YEARS PREPARED BY: GREG LOFLIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	4543438.	
B. SIOH	\$	227172.	
C. DESIGN COST	\$	227172.	
D. TOTAL COST (1A+1B+1C)	\$	4997782.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		4997782.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 10.14	53389.	\$ 541365.	13.81	\$ 7476244.
B. DIST	\$.00	0.	\$ 0.	17.57	\$ 0.
C. RESID	\$.00	0.	\$ 0.	21.40	\$ 0.
D. NAT G	\$ 4.17	*****	\$ -890529.	18.18	\$ -16189810.
E. COAL	\$ 2.01	106778.	\$ 214624.	15.15	\$ 3251550.
F. PPG	\$.00	0.	\$ 0.	13.59	\$ 0.
M. DEMAND SAVINGS			\$ 529200.	13.59	\$ 7191828.
N. TOTAL		-53389.	\$ 394660.		\$ 1729812.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ -125143.
(1) DISCOUNT FACTOR (TABLE A)	13.59	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ -1700693.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ -1700693.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 269517.

5. SIMPLE PAYBACK PERIOD (1G/4) 18.54 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 29119.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= .01
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -19.59 %

ROCK ISLAND ARSENAL ECO#3 - GAS TURBINE GENERATOR ECO 3B: 6 MW PEAK-SHAVING PLANT

BASELINE CALCULATIONS:

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
DAYS	31	28	31	30	31	30	31	31	30	31	30	31
MWH(purchased)	7756	6482	7798	7798	8232	8442	10394	8008	8064	7308	7182	7952
\$/MWH	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
KW(purchased)	18472	16594	17476	18144	18862	18887	19152	19228	19328	17136	17539	18358
\$/KW	5.75	5.75	5.75	5.75	5.75	10.55	10.55	10.55	10.55	5.75	5.75	5.75
TOTAL \$	331914	284042	327409	331250	348008	444920	504519	435888	438573	311195	309845	336962

ECO CALCULATIONS:

RUN HOURS	221	200	221	214	221	214	221	221	214	221	214	221
MWH(turbine)	1329	1200	1329	1286	1329	1286	1329	1329	1286	1329	1286	1329
MWH(purchased)	6427	5282	6469	6512	6903	7156	9065	6679	6778	5979	5896	6623
MW(turbine)	6	6	6	6	6	6	6	6	6	6	6	6
KW(purchased)	12472	10594	11476	12144	12862	12887	13152	13228	13328	11136	11539	12358
ENERGY SAVINGS (\$)	45969	41520	45969	44486	45969	44486	45969	45969	44486	45969	44486	45969
DEMAND SAVINGS (\$)	34500	34500	34500	34500	34500	63300	63300	63300	63300	34500	34500	34500
CCF NAT GAS	181377	163824	181377	175526	181377	175526	181377	181377	175526	181377	175526	181377
\$/CCF	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417
GAS COST	75634	68315	75634	73194	75634	73194	75634	75634	73194	75634	73194	75634
TURBINE MAINT	10629	9600	10629	10286	10629	10286	10629	10629	10286	10629	10286	10629
ELEC SAVINGS (\$)	80469	76020	80469	78986	80469	107786	109269	109269	107786	80469	78986	80469
HT RECOV'D (MBTU)	9069	8191	9069	8776	9069	8776	9069	9069	8776	9069	8776	9069
COAL SAVINGS (\$)	18228	16464	18228	17640	18228	17640	18228	18228	17640	18228	17640	18228

ANNUAL NAT GAS CONSUMPTION (MBTU) = 213556
 ANNUAL ELECTRIC SAVINGS (MBTU) = 53389
 ANNUAL COAL SAVINGS (MBTU) = 106778
 TOTAL ANNUAL ENERGY SAVINGS (MBTU) = -53389

ANNUAL ENERGY SAVINGS (\$) = 394537
 ANNUAL MAINTENANCE (\$) = 125143
 NET ANNUAL SAVINGS (\$) = 269394

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 14:18:27

1 PAGE

LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
COMPOSER Plus Copyright (C) 1985, 1988
by Building Systems Design, Inc.
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-20

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

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DETAILED ESTIMATE

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Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
 ECO-3B: 6 MW GAS TURBINE GENERATOR SET
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 14:18:27

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16200 POWER GENERATION									
16211 5000 CONTINUOUS DUTY GAS TURBINE GENERATOR SET WITH ACOUSTICAL ENCLOSURE, COMBUSTION & VENTILATION AIR FILTER UNIT, LUBE OIL SYSTEM, AND HYDRAULIC START SYSTEM, CONTROL PANEL W/ BATTERY BACKUP.									
CD=3 EL 5004 6 MW	*** UNIT COSTS: ***			1101	36372.33	1499.00	990000.00	49500	1077371
WC=1100	1.00 EA EELEH			1101	36,372	1,499	990,000	49,500	1,077,371
CD=3 EL 5005 6 MW	*** UNIT COSTS: ***			1101	36372.33	1499.00	990000.00	49500	1077371
WC=1100	1.00 EA EELEH			1101	36,372	1,499	990,000	49,500	1,077,371
CD=3 EL 5006 6 MW	*** UNIT COSTS: ***			0.00	0.00	0.00	990000.00	49500	1039500
WC=1100	1.00 EA EELEH			0	0	0	990,000	49,500	1,039,500
CD=3 EL 5013 6 MW	*** UNIT COSTS: ***			0.00	0.00	0.00	130000.00	6500	136500.00
WC=1100	1.00 EA EELEH			0	0	0	130,000	6,500	136,500
16400 SERVICE AND DISTRIBUTION									
16460 2000 SWITCHGEAR, KVA PAD MTD, TRANSFORMER, LIGHTNING ARRESTORS, FUSED LOAD INTERRUPTER SWITCH, SAFETY SWITCHES, AND PANEL BOARD									
CD=3 EL 2003 6000 KVA	*** UNIT COSTS: ***			300	9919.73	408.82	125000.00	6250	141578.55
WC=1100	1.00 EA EELEH			300	9,920	409	125,000	6,250	141,579
TOTAL DIVISION 16 ELECTRICAL				2503	82,664	3,407	3,225,000	161,250	3,472,321
TOTAL FACILITY AA. ELECTRICAL				2503	82,664	3,407	3,225,000	161,250	3,472,321
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				2503	82,664	3,407	3,225,000	161,250	3,472,321
TOTAL BASE BID				2503	82,664	3,407	3,225,000	161,250	3,472,321
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD LIMITED ENERGY STUDY				2503	82,664	3,407	3,225,000	161,250	3,472,321

* * * END OF DETAIL REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-22

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

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SUMMARY PAGE 1

(PROJECT NOTES

PROJECT NOTES

ECO-3: PEAK SHAVING / COGENERATION

SCOPE OF WORK: EVALUATE USE OF GENERATORS FOR PEAK SHAVING AND/OR
COGENERATION TO SAVE ELECTRICAL DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-23

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	3,472,321	347,232	0	286,466	102,650	0	4,208,670	4208670.33
BID ITEM TOTAL		1.00 EA	3,472,321	347,232	0	286,466	102,650	0	4,208,670	4208670.33

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-24

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

TIME 14:18:27

SUMMARY PAGE 3

ITEM AND FACILITY SUMMARY

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		3,472,321	347,232	0	286,466	102,650	0	4,208,670	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		3,472,321	347,232	0	286,466	102,650	0	4,208,670	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

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Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

TIME 14:18:27

SUMMARY PAGE 4

PROJECT CWE SUMMARY

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	4,208,670		4,208,670	4208670.30
	TOTAL CURRENT CONTRACT COST			4,208,670	0	4,208,670	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			4,208,670	0	4,208,670	
	Government-Furnished Property			0		0	
	SUBTOTAL			4,208,670	0	4,208,670	
	Contingencies	10.0%		420,867	0	420,867	
	SUBTOTAL			4,629,537	0	4,629,537	
	SIOH (S&A)	5.0%		231,477	0	231,477	
	CURRENT WORKING ESTIMATE			4,861,014	0	4,861,014	

Estimated Construction Time

365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-26

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

TIME 14:18:27

SUMMARY PAGE 5

CONTRACTOR DIRECT SUMMARY

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT *	* SUBCON *	W/OH&P	SUBTOTAL
										AMOUNT	PCT		
AA	GENERAL/PRIME		1.00	EA	2503	82,664	3,407	3,386,250		3,472,321	100.0%	0	3,472,321
	TOTAL DIRECT				2503	82,664	3,407	3,386,250		3,472,321	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGE

7-27

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

TIME 14:18:27

SUMMARY PAGE 6

TRACTOR INDIRECT SUMMARY

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		3,472,321	347,232	10.0%	0.0	286,466	7.5%	2.5%	0.0%	4,208,670	100.0%	4208670.33
	TOTAL OVERHEAD & PROFIT			347,232	10.0%		286,466	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-28

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

TIME 14:18:27

SUMMARY PAGE 7

DIVISION SUMMARY

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	2503	82,664	3,407	3,225,000	161,250	3,472,321
TOTAL DIRECT	2503	82,664	3,407	3,225,000	161,250	3,472,321

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-29

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

TIME 14:18:27

SUMMARY PAGE 8

MS SUMMARY

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	2503	82,664	3,407	3,225,000	161,250	3,472,321
TOTAL DIRECT	2503	82,664	3,407	3,225,000	161,250	3,472,321

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-30

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

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SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	ADJ FACTOR	ADJUSTD	BOOK OP	-- HRLY	--- UPB	**** TOTAL ****		
				OWNS	OVTH	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
ECR40 CRANE, 40 TON, TRUCK MTD. (3665)							38.93	38.93	79.	3,067	
EMI20 SMALL TOOLS							1.40	1.40	242	339	
TOTAL PROJECT EQUIPMENT HOURS										321	3,407

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3B: 6 MW GAS TURBINE GENERATOR SET

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SUMMARY PAGE 10

SUMMARY

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	2424	80,086
LOEHO EQ OPER, CRANE/SHOVL	21.40	0.0%	24.0%	6.20	0.00	32.74	24.39	79	2,580
TOTAL PROJECT MANHOURS								2503	82,666

*** END OF SUMMARY REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGB

7-32

7 ECO - 3 Calculations

7.3 ECO-3C: CALCULATIONS

This section contains the life cycle cost analysis, the energy calculations, and the cost estimate for ECO-3C: Install 24 MW Baseloaded Generating Plant at Building 160.

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE COGENERATION PLANT AT BUILDING 168		5. PROJECT NUMBER ECIP #3

1. INVESTMENT COSTS: A. CONSTRUCTION COST \$14,727,000³ B. SHIOH \$ 736,000 C. DESIGN COST \$ 736,000 D. TOTAL COST (1A+1B+1C) \$16,199,000 E. SALVAGE VALUE OF EXISTING EQUIPMENT 0 F. PUBLIC UTILITY COMPANY REBATE 0 G. TOTAL INVESTMENT (1D-1E-1F) \$16,199,000	
--	--

2. ENERGY SAVINGS (+) /COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS **OCTOBER 1992**

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS \$/MBTU(2)	ANNUAL \$ SAVINGS	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	\$ 8.53	\$ 717,500	\$6,121,000	13.81	\$ 84,527,000
B. DIST	\$	\$	\$	\$	\$
C. RESID	\$	\$	\$	\$	\$
D. NG	\$ 3.00	\$-2,242,400	\$-6,727,000	18.18	\$-122,300,000
E. PPG	\$	\$	\$	\$	\$
F. COAL	\$ 2.01	\$ 1,121,200	\$ 2,254,000	15.15	\$ 34,141,000
G. SOLAR	\$	\$	\$	\$	\$
H. GEOTH	\$	\$	\$	\$	\$
I. BIOMA	\$	\$	\$	\$	\$
J. REFUS	\$	\$	\$	\$	\$
K. WIND	\$	\$	\$	\$	\$
L. OTHER	\$	\$	\$	\$	\$
M. DEMAND			\$ 1,628,000	13.59	\$ 22,125,000
N. TOTAL		\$ -403,600	\$ 3,275,000		\$ 18,500,000

3. NON ENERGY SAVING (+) OR COST (-) :

A. ANNUAL RECURRING (+/-) \$ -430,720
 (1) DISCOUNT FACTOR (TABLE A-2) 13.59
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ -5,853,000

B. NON RECURRING SAVING (+) OR COST (-)

ITEM	SAVINGS (+) OR COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR (3)	DISCOUNTED SAVINGS (+) OR COST (-) (4)
a. Cost Avoidance	\$ 4,000,000	1	0.96	\$3,840,000
b. _____	\$ _____	_____	_____	\$ _____
c. _____	\$ _____	_____	_____	\$ _____
d. TOTAL	\$ 4,000,000	_____	_____	\$3,840,000

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3B4d) \$-2,013,000

4. SIMPLE PAYBACK 1G/ (2N3 + 2a): 5.7 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2n5 + 3C): \$16,487,000

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 1.02

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 4.1

³Escalated to Midpoint of Construction

ROCK ISLAND ARSENAL ECO#3 - GAS TURBINE GENERATOR ECO 3C: 24 MW BASELOADED PLANT

BASELINE CALCULATIONS:

DAYS	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
MWH(purchased)	7756	6482	7798	7798	8232	8442	10394	8008	8064	7308	7182	7952
\$/MWH	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
KW(purchased)	18472	16594	17476	18144	18862	18887	19152	19228	19328	17136	17539	18358
\$/KW	5.75	5.75	5.75	5.75	5.75	10.55	10.55	10.55	10.55	5.75	5.75	5.75
TOTAL \$	331914	284042	327409	331250	348008	444920	504519	435888	438573	311195	309845	336962

ECO CALCULATIONS:

RUN HOURS	744	672	744	720	744	720	744	744	720	744	720	744
MWH(turbine)	17856	16128	17856	17280	17856	17280	17856	17856	17280	17856	17280	17856
MWH(purchased)	0	0	0	0	0	0	0	0	0	0	0	0
MW(turbine)	24	24	24	24	24	24	24	24	24	24	24	24
KW(purchased)	0	0	0	0	0	0	0	0	0	0	0	0
ENERGY SAVINGS (\$)	519610	469325	519610	502848	519610	502848	519610	519610	502848	519610	502848	519610
DEMAND SAVINGS (\$)	138000	138000	138000	138000	138000	253200	253200	253200	253200	138000	138000	138000
CCF NAT GAS	1904454	1720152	1904454	1843020	1904454	1843020	1904454	1904454	1843020	1904454	1843020	1904454
\$/CCF	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417
GAS COST	794157	717303	794157	768539	794157	768539	794157	794157	768539	794157	768539	794157
TURBINE MAINT	53568	48384	53568	51840	53568	51840	53568	53568	51840	53568	51840	53568
ELEC SAVINGS (\$)	657610	607325	657610	640848	657610	756048	772810	772810	756048	657610	640848	657610
HT RECOV'D (MBTU)	95223	86008	95223	92151	95223	92151	95223	95223	92151	95223	92151	95223
COAL SAVINGS (\$)	191398	172875	191398	185224	191398	185224	191398	191398	185224	191398	185224	191398

ANNUAL NAT GAS CONSUMPTION (MBTU) = 2242341
ANNUAL ELECTRIC SAVINGS (MBTU) = 717549
ANNUAL COAL SAVINGS (MBTU) = 1121171
TOTAL ANNUAL ENERGY SAVINGS (MBTU) = -403621

ANNUAL ENERGY SAVINGS (\$) = 1137775
ANNUAL MAINTENANCE (\$) = 630720
NET ANNUAL SAVINGS (\$) = 507055

Thu 30 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 15:32:12

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LIMITED ENERGY STUDY
ROCK ISLAND ARSENAL, IL
ECO-3C: 24 MW GAS TURBINE GENERATOR SET

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: GREG B. LOGLIN
Estimate Prep. Date: 10/11/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3C: 24 MW GAS TURBINE GENERATOR SET

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DETAILED ESTIMATE

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3C: 24 MW GAS TURBINE GENERATOR SET
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

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DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL				QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT S

16200 POWER GENERATION												
16211 5000 CONTINUOUS DUTY GAS TURBINE GENERATOR SET WITH ACOUSTICAL ENCLOSURE, COMBUSTION & VENTILATION AIR FILTER UNIT, LUBE OIL SYSTEM, AND HYDRAULIC START SYSTEM, CONTROL PANEL W/ BATTERY BACKUP.												
CD=3 EL 5008	24 MW	*** UNIT COSTS: ***	3304	109117.00				4497.00	900000.00	45000	1058614	
WC=1100		1.00 EA EELEH	3304	109,117				4,497	900,000	45,000	1,058,614	
CD=3 EL 5009	24 MW	*** UNIT COSTS: ***	3304	109117.00				4497.00	900000.00	45000	1058614	
WC=1100		1.00 EA EELEH	3304	109,117				4,497	900,000	45,000	1,058,614	
CD=3 EL 5010	24 MW	*** UNIT COSTS: ***	551	18186.17				749.50	900000.00	45000	963935.67	
WC=1100		1.00 EA EELEH	551	18,186				750	900,000	45,000	963,936	
CD=3 EL 5011	24 MW	*** UNIT COSTS: ***	0.00	0.00				0.00	900000.00	45000	945000.00	
WC=1100		7.00 EA EELEH	0	0				0	6,300,000	315,000	6,615,000	

16400 SERVICE AND DISTRIBUTION												
16460 2000 SWITCHGEAR, KVA PAD MTD, TRANSFORMER, LIGHTNING ARRESTORS, FUSED LOAD INTERRUPTER SWITCH, SAFETY SWITCHES, AND PANEL BOARD												
CD=3 EL 2001	24,000 KVA	*** UNIT COSTS: ***	661	21823.40				899.40	500000.00	25000	547722.80	
WC=1100		1.00 EA EELEH	661	21,823				899	500,000	25,000	547,723	

TOTAL DIVISION 16 ELECTRICAL				7819	258,244			10,643	9,500,000	475,000	10,243,886	

TOTAL FACILITY AA. ELECTRICAL				7819	258,244			10,643	9,500,000	475,000	10,243,886	

TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				7819	258,244			10,643	9,500,000	475,000	10,243,886	

TOTAL BASE BID				7819	258,244			10,643	9,500,000	475,000	10,243,886	

TOTAL ADDITIVE				0	0			0	0	0	0	

TOTAL INCL ADD LIMITED ENERGY STUDY				7819	258,244			10,643	9,500,000	475,000	10,243,886	

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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U.S. ARMY CORPS of ENGINEERS M-CACES
LIMITED ENERGY STUDY / ROCK ISLAND ARSENAL, IL
ECO-3C: 24 MW GAS TURBINE GENERATOR SET

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SUMMARY PAGE 1

PROJECT NOTES

PROJECT NOTES

ECO-3: PEAK SHAVING / COGENERATION

SCOPE OF WORK: EVALUATE USE OF GENERATORS FOR PEAK SHAVING AND/OR
COGENERATION TO SAVE ELECTRICAL DEMAND.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	10,243,886	1,024,389	0	845,121	302,835	0	12,416,231	12416231
BID ITEM TOTAL		1.00 EA	10,243,886	1,024,389	0	845,121	302,835	0	12,416,231	12416231

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		10,243,886	1,024,389	0	845,121	302,835	0	12,416,231	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		10,243,886	1,024,389	0	845,121	302,835	0	12,416,231	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	12,416,231		12,416,231	12416230.60
	TOTAL CURRENT CONTRACT COST			12,416,231	0	12,416,231	
	Cost Growth from 10/93 to 10/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			12,416,231	0	12,416,231	
	Government-Furnished Property			0		0	
	SUBTOTAL			12,416,231	0	12,416,231	
	Contingencies	10.0%		1,241,623	0	1,241,623	
	SUBTOTAL			13,657,854	0	13,657,854	
	SIOH (S&A)	5.0%		682,893	0	682,893	
	CURRENT WORKING ESTIMATE			14,340,746	0	14,340,746	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	7819	258,244	10,643	9,975,000	10,243,886	100.0%		0	10,243,886
	TOTAL DIRECT				7819	258,244	10,643	9,975,000	10,243,886	100.0%			

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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CONTRACTOR INDIRECT SUMMARY

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		10,243,886	1,024,389	10.0%	0.0	845,121	7.5%	2.5%	0.0%	12,416,231	100.0%	12416231
	TOTAL OVERHEAD & PROFIT			1,024,389	10.0%		845,121	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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DIVISION SUMMARY

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	7819	258,244	10,643	9,500,000	475,000	10,243,886
TOTAL DIRECT	7819	258,244	10,643	9,500,000	475,000	10,243,886

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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SUMMARY PAGE 8

EMS SUMMARY

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	7819	258,244	10,643	9,500,000	475,000	10,243,886
TOTAL DIRECT	7819	258,244	10,643	9,500,000	475,000	10,243,886

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: CDGTGC

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EQUIP	DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY	UPB	*****	TOTAL	*****
										RATE	RATE	HOURS		COST
ECR40	CRANE, 40 TON, TRUCK MTD. (3665)									38.93	38.93	246		9,582
EMI20	SMALL TOOLS									1.40	1.40	757		1,060
												1003	10,642	
TOTAL PROJECT EQUIPMENT HOURS														

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OR SUMMARY

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CRAFT	DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	7573	250,185
LOEHO	EQ OPER, CRANE/SHOVL	21.40	0.0%	24.0%	6.20	0.00	32.74	24.39	246	8,058
TOTAL PROJECT MANHOURS									7819	258,243

* * * END OF SUMMARY REPORT * * *

8 Narrative Summary of Work and Results

This section of the report includes a narrative summary of the work accomplished to date. The project is divided into three (3) major tasks: The field survey, the energy baseline and energy conservation opportunities. We have described the performance of these tasks in the following three (3) sections. Finally, in the last section, we outline our recommendations and suggestions for implementing the ECOs and combining them into projects.

8.1 FIELD SURVEY

The field survey was performed September 7-10, 1993. It resulted in obtaining all available drawings and completing all survey work necessary for the ECOs. Interviews were conducted throughout the week.

During the interviews, the general results of the field survey were discussed. Each ECO was discussed along with preliminary suggestions pertaining to each project.

The survey was performed by one survey team of two (2) engineers. The survey was performed between the hours of 7:30 a.m. and 5:00 p.m. All of the buildings were surveyed that were included in the scope of work.

A high level of cooperation and support by DEH, and maintenance and building occupant personnel has contributed substantially to the success of the survey.

8 Narrative Summary of Work and Results

8.2 ENERGY BASELINE

After completing the field survey, the next task was to establish the baseline energy consumption for each ECO under evaluation. The approach taken was to determine the baseline energy consumption for the system analyzed within each building. The baseline energy consumption therefore only pertains to the ECOs calculated in each building.

The baselines were determined using data from many sources. These sources include:

- field survey notes
- as-built drawings
- past experience of Systems Corp
- manufacturer's catalog data
- manufacturer's performance data
- building occupants

Before preparing the energy baseline, each ECO was reviewed with respect to the information now available. A decision was then made on the applicability of each ECO to the particular building (or area).

After completing the energy baseline, the results were reviewed for technical correctness and feasibility. When problems were found, the calculations were revised and corrected.

The baseline energy for each ECO is given in *Table 8.2.1*.

8.3 ENERGY CONSERVATION OPPORTUNITIES

The energy consumption for each of the energy conservation opportunities was calculated after the successful run of the baseline calculations. Calculation of the ECO's requires preparing a very conceptual design which would allow implementation of the ECO. It is important to note that an ECO may be implemented in several ways. The designer must carefully consider the options to assure that the chosen design is the most likely to result in a savings that can justify the investment. After completing the conceptual design, the energy results were calculated by computer spreadsheets.

8 Narrative Summary of Work and Results

The calculations were then reviewed for accuracy and technical feasibility. Where problems were discovered, corrections were made and the calculations were revised.

8 Narrative Summary of Work and Results

TABLE 8.2.1		
ENERGY BASELINE FOR ALL ECOs		
ECO NUMBER	ECO NAME	BASELINE ENERGY CONSUMPTION (MBTU)
1A	FLUORESCENT FIXTURE REPLACEMENTS - BUILDING 220	10,663
1B	FLUORESCENT FIXTURE RETROFIT - BUILDING 220	10,663
1C	MERCURY VAPOR FIXTURE REPLACEMENTS - BUILDING 220	2,090
1D	EXIT SIGN RETROFIT - BUILDING 220	52.6
2A	FLUORESCENT FIXTURE REPLACEMENTS - BUILDING 350	1991
2B	OCCUPANCY SENSOR INSTALLATION - BUILDING 350	664
2C	FLUORESCENT FIXTURE REPLACEMENTS - BUILDING 350	17,838
2D	INCANDESCENT FIXTURE REPLACEMENTS - BUILDING 350	405.5
2E	EXIT SIGN RETROFITS - BUILDING 350	94.4
3A	INSTALL 1 MW PEAK-SHAVING GENERATOR - BUILDING 160	717,549
3B	INSTALL 6 MW PEAK-SHAVING GENERATOR - BUILDING 160	824,327
3C	INSTALL 24 MW BASELOADED GENERATOR - BUILDING 168	1,838,720

8 Narrative Summary of Work and Results

After completing the energy calculations for each ECO, the cost estimates and economic analyses were prepared. A standardized bill of materials was prepared for each ECO. Material sizes, quantities, and prices were prepared to represent specific conditions of the ECO. Annual and non-annual recurring costs are an important part of the life cycle cost for a given project. Each ECO is evaluated individually to determine the correct difference in these costs between the current condition and the future condition.

Following is a description of how the calculations were performed in terms of the energy-efficient replacement products used.

8.3.1 ECO-1A: Fluorescent Fixture Replacements in Building 220

This ECO evaluated the feasibility of changing out all the existing 4- and 8-foot T-12 fluorescent fixtures in Building 220 and replacing them with new 4-foot T-8 fluorescent fixtures utilizing high efficiency lamps, ballasts, and reflectors. The new system provides the same light output as the existing system in all areas, and in many cases provides more light than currently provided. This ECO provides a one-for-one fixture replacement, however the number of lamps has been reduced due to reflector usage. The existing 8-foot fixtures are replaced by two 4-foot fixtures. The existing 8-foot fixtures were a conglomeration of standard wattage (60 watt), high output (110 watt), and very high output (215 watts) lamps, all using standard efficiency ballasts. The existing 4-foot fixtures were mainly economy watt (32 watt) bulbs with some very high output (115 watts) bulbs, both employing standard efficiency ballasts.

8.3.2 ECO-1B: Fluorescent Fixture Retrofit in Building 220

This ECO utilizes the same technology as ECO-1A, however this ECO would reduce initial costs by utilizing the existing fixtures as much as possible. The use of a retrofit kit to convert existing T-12 fixtures to T-8 fixtures includes electronic ballasts, T-8 lamps, and reflectors applied to the existing fixtures. Again, the existing 8-foot fixtures are replaced by two 4-foot fixtures due to the unreliable nature of the 8-foot T-8 ballasts currently available on the market.

8 Narrative Summary of Work and Results

8.3.3 ECO-1C: Mercury Vapor Fixture Replacement in Building 220

This ECO evaluated the change out of the existing mercury vapor fixtures in high bay areas of Building 220. The existing fixtures provide light in the areas known as "the Craneway" and "Honing and NC Lathe Shop". In the Craneway the 1000 watt mercury vapor fixtures are replaced on a two-for-one basis by 1000 watt metal halide fixtures, providing more light than existing conditions. In the Lathe Shop, existing 400 watt mercury vapors are replaced two-for-one with 400 watt metal halides, also providing more light output than existing conditions. Eight existing 750 watt mercury vapors located underneath the movable crane in the Lathe Shop are replaced one-for-one by 450 watt metal halide fixtures.

8.3.4 ECO-1D: Exit Sign Retrofits in Building 220

This ECO proposes to use a retrofit kit to convert existing 40 watt incandescent exit signs to 3 watt light-emitting diode (L. E. D.) fixtures. The retrofit kit provides for hard-wiring the L.E.D. fixtures in place so that a return to incandescent lamp usage is not possible. The L.E.D. has a minimum life expectancy of 25 years without maintenance.

8.3.5 ECO-2A: Fluorescent Fixture Replacements in Building 350 - Office Area

This ECO evaluated the feasibility of changing out all the existing 4-foot T-12 Fluorescent fixtures in Building 350 and replacing them with new 4-foot T-8 fluorescent fixtures utilizing high efficiency lamps, ballasts, and reflectors. The new system provides the same light output as the existing system in all areas, and in many cases provides more light than currently provided. This ECO provides a one-for-one fixture replacement, however the number of lamps has been reduced due to reflector usage. Unlike Building 220, the existing 4-foot fixtures in Building 350 were found to be mainly standard wattage lamps (40 watts each), thus the calculations for this ECO reflect a higher existing wattage per fixture than that of ECO-1A and ECO-1B.

8 Narrative Summary of Work and Results

8.3.6 ECO-2B: Installation of Occupancy Sensors in Building 350 - Office Area

ECO-2B was the installation of 250 occupancy sensors in the perimeter office areas of Building 350. The field survey revealed that approximately half of the office areas had lights left on by occupants after hours. Also, during working hours approximately one-half of the offices were unoccupied at any one time. Thus the on-time of lights in this area were assumed to be one-half of the baseline for the calculation of the ECO.

This ECO does not provide occupancy sensors in the core area offices. Due to the large number of sensors that would be required in these modular-style offices, the application was deemed infeasible.

8.3.7 ECO-2C: Fluorescent Fixture Replacements in Building 350 - Core Area

This ECO evaluated the feasibility of changing out all the existing 4- and 8-foot T-12 fluorescent fixtures in the core area of Building 350 and replacing them with new 4-foot T-8 fluorescent fixtures utilizing high efficiency lamps, ballasts, and reflectors. The new system provides the same light output as the existing system in all areas, and in many cases provides more light than existing fixtures. This ECO provides a one-for-one fixture replacement, however the number of lamps has been reduced due to reflector usage. The existing 8-foot fixtures are replaced by two 4-foot fixtures. As in ECO-2A, 40 watt lamps were observed in use, and were used in the baseline calculations.

This area was separated from the office area of Building 350 due to the different utilization times of the lights in the core and office areas. The lights in the core area were observed during the field survey to stay on 24 hours a day. The reason given for this was for security purposes. Therefore, in this ECO, the addition of 18 compact fluorescent fixtures in the core area was incorporated so that the existing lights could be shut off during unoccupied hours. The compact fluorescent fixtures will provide sufficient security lighting during off-hours.

8 Narrative Summary of Work and Results

8.3.8 ECO-2D: Incandescent Fixture Replacements in Building 350

ECO-2D involves replacing 277 incandescent fixtures with fluorescent fixtures throughout Building 350. A total of 193 lower-wattage fixtures will be replaced with compact fluorescent fixtures and eighty-four 200 and 300 watt fixtures are to be replaced by 4-foot T-8 fixtures. The bulk of the smaller-wattage fixtures are located in restrooms and stairwells, with a few located in recessed spotlight fixtures in conference rooms and offices. The 200 and 300 watt fixtures are all located in mechanical rooms where about half of the total were found to be on all day, and the other half, off all day.

8.3.9 ECO-2E: Exit Sign Retrofits in Building 350

This ECO proposes to use a retrofit kit to convert existing 40 watt incandescent exit signs to 3 watt light-emitting diode (L. E. D.) fixtures. The retrofit kit provides for hard-wiring the L.E.D. fixtures in place so that a return to incandescent lamp usage is not possible. The L.E.D. has a minimum life expectancy of 25 years without maintenance.

8.3.10 ECO-3A: Install 1 MW Peak-Shaving Plant at Building 160

ECO-3A evaluates the installation of a 1 MW natural gas/diesel engine-generator set to provide electrical demand peak-shaving capabilities for the Arsenal. The run time of the engine was determined from historical electrical demand profiles provided by the installation. The low amount of run time associated with the generator installation (about four hours per day, five days per week) provides for limited opportunities of heat recovery and utilization, and was deemed infeasible for this ECO. The annual maintenance cost used in the analysis was \$0.01 per kilowatthour of engine run time.

8.3.11 ECO-3B: Install 6 MW Peak-Shaving Plant at Building 160

ECO-3B was evaluated similarly to ECO-3A, however in this size generating equipment

8 Narrative Summary of Work and Results

a natural gas/diesel turbine is more practical than a gas engine. The increased run time (about ten hours per day, five days per week) with this ECO allowed the consideration of heat recovery from the turbine. A heat recovery steam boiler package was chosen so that about 35,000 lbs/hr of 135 psig steam could be generated for injection into the Arsenal's central steam system. This requires making steam line tie-ins, water treatment, and handling of the condensate from the system, which was all included in the cost estimate.

8.3.12 ECO-3C: Install 24 MW Base Loaded Generating Plant at Building 160

This ECO was evaluated in the same manner as ECO-3B with the only difference being that ECO-3C provides for generating all the power that is currently purchased by the Arsenal by means of four 6 MW natural gas/diesel turbine-generators. The heat recovered from the turbine set is used to generate 110,000 lb/hr of 135 psig steam for use by the installation at the peak electrical demand of 24 MW.

Due to the size of the installation with four turbines, an alternative site to Building 160 was chosen. Building 168 (the old heating plant) was chosen since it is an open area building of 8,349 ft². This site will provide some investment savings for the project as some of the steam lines are still in place. As an alternative to this site, a new facility could be built next to the present heating plant.

In preparing the life cycle cost analysis for this ECO, a much cheaper gas rate was used. If this ECO was implemented, the Arsenal would most likely buy gas from a direct supplier due to the large quantities of gas involved. Thus a rate of \$3.00/MBTU was used in the analysis. See *Section 11, page 36* for documentation.

As mentioned previously, a maintenance savings of at least \$200,000 is anticipated by the Arsenal engineering staff due to the shutdown of the existing steam plant for three to four months during the summer. The heat recovered from the 24 MW cogeneration facility will provide more than enough steam to meet the Arsenal's needs during the summer.

Additionally, an investment savings of \$4 million is taken for this ECO since the proposed 24 MW facility will serve to provide backup power to Building 350. A

8 Narrative Summary of Work and Results

detailed estimate for providing an emergency generator installation for Building 350 has been performed by DEH which indicated the cost to be over \$4 million for the required project. Thus, if the cogeneration facility is built, Building 350 has prime power supplied by the on-site turbine generators and emergency power provided by the existing Iowa and Illinois Electric Utility tie-in. Therefore, the life cycle cost analysis for ECO-3C reflects a \$4 million credit (the credit was placed in Year 1 of Non-Recurring, Non-Energy Savings on the Life Cycle Cost Form).

It should be mentioned that the initial cost of ECO-3C (and ECO's 3A and 3B) could be significantly reduced even further by the use of surplus or reconditioned generators sets. However, this method of purchase is limited by the availability of the equipment (i.e.-a set of four 6 MW dual-fuel turbines may not be available on the surplus market at the time of construction).

facility

LIGHTING IMPROVEMENTS IN BUILDING 220

Rock Island Arsenal, Illinois

project coordinator for using service

David Osborn

functional requirements summary, PDB-1

9-1

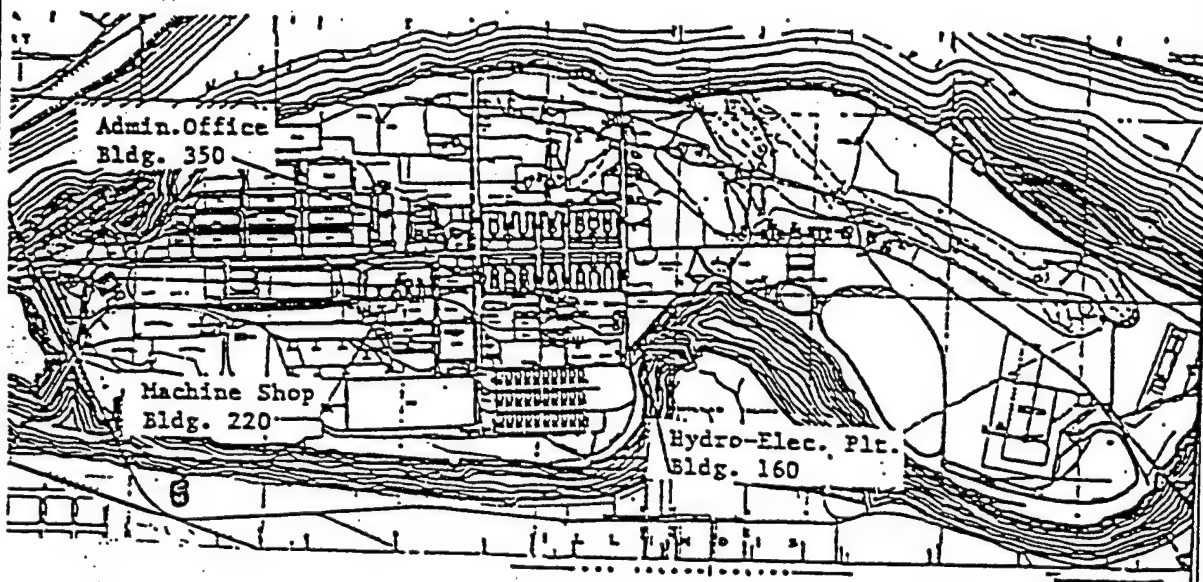
OBJECTIVE:

The objective of this project is to replace existing interior lighting with higher efficiency fixtures and lamps. The replacement of the existing lighting will reduce energy consumption and life cycle operating costs for the subject facilities in accordance with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759.

functional requirements summary, PDB-1

9-2

U. S. ARMY
ROCK ISLAND ARSENAL, ILLINOIS



facilities requirements sketch, PDB- 1/2

9-3

APPENDIX C
DOCUMENTATION CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
A-1	Cost estimates for each primary and supporting facility	NR			
A-2	Telecommunications system coordination with USACC and authorization for exceptions	NR			
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse coordination, etc.)	R	A		
A-4	Assignment of airspace	NR			
A-5	Economic analysis of alternatives	R	D		
A-6	Approval for new starts	NR			
A-7	International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)	NR			
A-8	Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	R	A		
A-9	Exceptions to established criteria	NR			
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)	R			
A-11	Identification of related or support projects (so projects can be coordinated)	R			
A-12	Required completion date	R			
Other Special Considerations (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

BY WHOM (Check and insert appropriate letter)

- A — DFAE
- B — Using Service
- C — Construction Service
- D — Designer
- E — Other (Check Comments Attached and explain)

documentation checklist

9-5

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Consultation with the District Office to determine and evaluate flood plain hazards	NR			
B-2	Preparation, submission, and/or approval of new	NR			
(A)	General Site Plan	NR			
(B)	Annotated General Site Plan	NR			
(C)	Sketch Site Plan				
(D)	Facilities Requirements Sketch	NR			
B-3	Preparation of				
(A)	Site Survey	NR			
(B)	Subsoil information	NR			
B-4	Approval by Department of Defense Explosive Safety Board (DDESB) for Safety Site Plan	NR			
Other Site Development Considerations (List and number items)					
1. See Project Development Brochure, PDB-1/2					

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E — Other (Check Comments Attached and explain)

documentation checklist

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	R	D		1
C-3	Approval for removal and relocation of existing useable facilities	NR			
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with installation where sited	NR			
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item B-4)	NR			
C-18	Analysis of deficiencies	R	D		1
C-19	Consideration of alternatives	R	D		2
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-built drawings for alterations or additions	R	C		
C-22	Availability of Standard Design or site adaptable designs	NR			
Other Architectural & Structural (List and number items)					
1. See Supplemental Data Detailed Project Justification Paragraph D3.					
2. See Supplemental Data Detailed Project Justification Paragraph D4.					

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documentation checklist

9-7

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
D-1	Fuel considerations and cost comparison analysis	R	D		
D-2	Energy requirements appraisal (ERA)	R	D		I
D-3	Conformance with DOD Energy Reduction requirements	R	D		
D-4	Evaluation of existing and/or proposed utility systems	R	D		
Other Mechanical and Utility Systems (List and number items)					
1. See Special Requirements, Paragraph 3 (SRP-3)					

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E — Other (Check Comments Attached and explain)

documentation checklist

9-8

E. ENVIRONMENTAL CONSIDERATIONS

ITEM

E-1	Environmental impact assessment
E-2	EIA conclusions require Environmental Impact Statement
E-3	Determination of health, environmental or related hazards. Assistance to determine existence of any health, environmental or related hazard may be requested from Aberdeen Proving Ground, MD 21010, the Office of the Surgeon General, Attn: DASG-HCH (Army Environmental Hygiene Agency)
E-4	Air/water pollution permit, coordination with agencies and compliance with standards at Federal, state and local level
E-5	Corrective measures associated with Environmental Impact Statements or assessment—list separately and evaluate.

Other environmental considerations (list and number items)

1. SEE SUPPLEMENTAL DATA
DETAILED PROJECT JUSTIFICATION
PARAGRAPH D9.

Required or Not Required	To Be * Determined	Comment Attached	Document Attached
R	D		1
NR			
NR			
NR			
NR			

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E — Other (Check Comments Attached and explain)

documentation checklist

9-9

APPENDIX D
TECHNICAL DATA CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM

A-1	Factor of risk, restriction or unusual circumstance expected to increase costs beyond applicable area average
A-2	Construction phasing requirements
A-3	Functional support equipment (mechanical, electrical, structural, and security) to be built in
A-4	Equipment in place and justification
A-5	Other equipment and furniture (D&MA, OPA) and costs
A-6	Special studies and tests (hazard analysis, compatibility testing, new technology testing, etc.)
A-7	Type of construction (permanent, temporary, semi-permanent)
A-8	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.
	Other special considerations (list and number items)

Required or Not Required	To Be Determined	Comment Attached	Document Attached
NR			
R	D		
NR			
NR			
NR			
NR			
NR			
NR			
NR			

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C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

9-11

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Construction restrictions or guidelines pertaining to site access and preferred construction routes	R	A		
(A)		NR			
(B)	Airfield clearance, explosive storage, working hours, safety, etc.				
(C)	Facilities and/or functions of adjoining areas (structures, materials, impact)	NR			
B-2	Real estate actions (acquisition, disposal, lease, right-of-way)	NR			
B-3	Demolition/relocation required (data)				
(A)	Special considerations due to explosives/radioactivity/chemical contamination/asbestos emissions/toxic gases	R	A	1	
(B)	Restrictions on disposal of demolished/relocated material including hazardous waste	NR			
B-4	Pavement types and requirements (including traffic surveys and MTMC coordination)	NR			
B-5	Landscape considerations				
(A)	Protection of existing vegetation	NR			
(B)	Stockpile topsoil	NR			
Other Site Development (List and number items)					
1. There is a possibility that the existing lighting may contain PCB's in the ballasts.					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

9-12

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation	NR	D		
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)	NR			
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)	NR			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)	NR			
C-5	Designation and strength of units to be accommodated	NR			
C-6	Requirements and data for special design projects	NR			
C-7	Unusual floor and roof loads (safes, equipment)	NR			
C-8	Security features (arms rooms, vaults, interior secure areas)	NR			
Other Architectural & Structural (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

9-13

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	NR			
D-2	Special peak usage periods and peak leveling techniques	NR			
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	D		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	NR			
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	NR			
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	NR			
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	R	D		
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	NR			
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	R	D		
D-10	Solar energy evaluation	NR			
Other Mechanical & Utility Systems (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

9-14

E. ENVIRONMENTAL CONSIDERATIONS

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
E-1	Waste water treatment, air quality, and solid waste disposal criteria	NR			
	Other Environmental Considerations (List and number items)				

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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*** BY WHOM** (Check and insert appropriate letter)

- A — DFAE
- B — Using Service
- C — Construction Service
- D — Designer
- E — Other (Check Comments Attached and explain)

technical data checklist

9-15

F. FIRE PROTECTION

ITEM		Regul Not R	To Be Delet	Comm Attac	Docu Attac
F-1	Special fire protection systems or features (detection and suppression equipment, hazards, etc.)	NR			
	Other Fire Protection Considerations (List and number items)				

REQUIRED OR NOT REQUIRED - Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED - Information needed but not currently available.
Enter code for information source.

COMMENT ATTACHED - Significant information summarized or explained and attached.

DOCUMENT ATTACHED - Significant information is in an existing document which is attached.

* BY WHOM (Check and insert appropriate letter)

A - DFAE

B - Using Service

C - Construction Service

D - Designer

E - Other (Check Comments Attached and explain)

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA			2. DATE 1 November 93	
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220			
5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER ECIP #1	8. PROJECT COST (\$000) \$1024		
9. COST ESTIMATES ¹					
ITEM		U/M	QUANTITY	UNIT COST	COST (\$000)
Primary Facility					
Interior Light Fixtures and Controls		Lot	1	966,000 ²	966
Subtotal					966
Design (5%)					50
Total Contract Cost					1016
Supervision, Inspection and Overhead (5%)					50
Total Request					1066
<p>10. DESCRIPTION OF PROPOSED CONSTRUCTION</p> <p>The existing interior lighting is a combination of standard efficiency fluorescent fixtures and mercury vapor. The proposed project will replace the interior lighting fixtures with T-8 fluorescent and high efficiency electronic ballasts and metal halide fixtures. The implementation of this project will save 7,440 MBtu/Yr of electrical energy (site). The first year savings is \$201,418 and the Savings to Investment Ratio (SIR) is 2.1.</p> <p>11. REQUIREMENT</p> <p>Project: The proposed interior lighting project replaces inefficient lighting in Building 220 with energy efficient lighting.</p> <p>Requirement: The project is required to reduce the energy consumption of lighting and to comply with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759. The proposed project will reduce annual energy consumption by 7,440 MBtu/Yr and annual energy cost by \$109,747.</p> <p>Current Situation: The existing lighting in Building 220 is inefficient fluorescent and mercury vapor.</p>					
¹ See Attached Detail Cost Estimate					
² Cost Has Been Escalated to Midpoint of Construction					

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA		2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois			
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220		5. PROJECT NUMBER ECIP #1	
<p>Impact if not provided: If the proposed project is not funded, a reduction of 7,440 MBtu/Yr cannot be achieved, and excessive amounts of energy will continue to be used. There will be no contribution to energy reduction goals established for United States Army facilities by Army Headquarters.</p>			
<p style="text-align: center;">_____ Colonel, USA Commanding</p>			
ESTIMATED CONSTRUCTION START:		September 1994	INDEX: 4.3
ESTIMATED MIDPOINT OF CONSTRUCTION:		March 1995	INDEX: 2.25
ESTIMATED CONSTRUCTION COMPLETION:		September 1995	INDEX: --
DETAILED JUSTIFICATIONS			
D1. GENERAL			
<p>The proposed project encompasses the replacement of lighting in Building 220. The project will decrease the energy consumption of the lighting systems without reducing light levels.</p>			
D2. ACCOMMODATIONS NOW IN USE:			
<p>The existing lighting systems are comprised of standard efficiency fluorescent and mercury vapor fixtures.</p>			
D3. ANALYSIS OF DEFICIENCY:			
<p>Currently, the building is using standard or low efficiency fixtures for lighting. The purpose of this project is to replace the existing lighting with new light fixtures which are much more efficient. The current deficiency results in large amounts of energy usage to maintain adequate lighting.</p>			

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220		5. PROJECT NUMBER ECIP #1
<p>D4. CONSIDERATION OF ALTERNATIVES:</p> <p>The only alternatives to proposed project are to install lower efficiency light fixtures. The disadvantages of using lower efficiency light fixtures is that less energy savings can be realized without significantly reducing the construction cost. If a less energy efficient fixture is selected, the project would have a lower SIR.</p> <p>D5. CRITERIA FOR PROPOSED PROJECT:</p> <p>The proposed project will conform will all applicable federal and United States Army Regulations.</p> <p>D6. PROGRAM FOR RELATED EQUIPMENT:</p> <p>No equipment funded from appropriations other than MCA are required.</p> <p>D7. DISPOSAL OF PRESENT ASSETS:</p> <p>Light fixtures in one building will be disposed.</p> <p>D8. SURVIVAL FACILITIES:</p> <p>The proposed project is not suitable for inclusion of protective shelters.</p> <p>D9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES:</p> <p>The proposed project has been analyzed and will not adversely impact the environment. Energy savings resulting from the project will conserve natural resources.</p> <p>D10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS:</p> <p>It has been determined that these facilities are not located in a flood plain and they do not encroach on wetlands.</p> <p>D11. ECONOMIC JUSTIFICATION:</p> <p>The proposed project qualifies under ECIP Guidelines in AR-415-15. SIR for the project is 2.1 with a simple payback of 5.3 years.</p> <p>See Economic Analysis, SRP-1</p>		

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220		5. PROJECT NUMBER ECIP #1
<p>D12. UTILITY AND COMMUNICATION SUPPORT:</p> <p>A. No related utility support projects are programmed. Adequate utilities are available to support the project.</p> <p>B. No telecommunication support is required.</p> <p>D13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES:</p> <p>The project involves the replacement of light fixtures in existing buildings. Review procedures have been implemented for this project in accordance with 36 CFT 800.</p> <p>D14. PROJECT DEVELOPMENT BROCHURE (PART 1):</p> <p>A Project Development Brochure was prepared on 1 November 93 and is attached as a part of the programming documentation.</p> <p>D15. ENERGY REQUIREMENTS:</p> <p>The proposed project will reduce present energy consumption by 7,440 MBtu/Yr at a cost savings of \$201,418. See Energy Requirements Appraisal (ERA) in Special Requirements, Paragraph 3 (SRP-3).</p> <p>D16. PROVISION FOR THE HANDICAPPED:</p> <p>No provisions for the handicapped will be made since the scope of the project is in no way applicable to designing for the handicapped.</p> <p>D17. REAL PROPERTY MAINTENANCE ACTIVITY (RPMA) ANALYSIS:</p> <p>A. Physical impact: No new structures will be added.</p>		

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93										
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois												
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220		5. PROJECT NUMBER ECIP #1										
<p>B. Operations and Maintenance (O&M) impact:</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;"><u>YEAR</u></th> <th style="text-align: center;"><u>O&M</u> <u>NET CHANGE (\$000)</u></th> </tr> </thead> <tbody> <tr> <td>1994</td> <td style="text-align: center;">0.0</td> </tr> <tr> <td>(BOD)</td> <td style="text-align: center;">0.0</td> </tr> <tr> <td>1995</td> <td style="text-align: center;">0.0</td> </tr> <tr> <td>1996</td> <td style="text-align: center;">0.0</td> </tr> </tbody> </table> <p>C. Backlog of Maintenance and Repair (BMAR) impact:</p> <p>There will be no net increase in the number of fixtures, or in fixture life expectancy. There will be no effect on BMAR.</p> <p>D18. COMMERCIAL ACTIVITIES:</p> <p>The proposed project is not a "New Start Expansion" as defined by DA Circular 235-1. The project has been reviewed in light of the requirements of commercial and industrial facilities. It has been determined that whereas the project does not affect commercial facilities, the requirements of DA Circular 235-1 does not apply.</p>			<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>	1994	0.0	(BOD)	0.0	1995	0.0	1996	0.0
<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>											
1994	0.0											
(BOD)	0.0											
1995	0.0											
1996	0.0											

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220		5. PROJECT NUMBER ECIP #1

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$ 907,000 ³
B. SIOH	\$ 45,000
C. DESIGN COST	\$ 45,000
D. TOTAL COST (1A + 1B + 1C)	\$ 997,000
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$ 0
F. PUBLIC UTILITY COMPANY REBATE	\$ 0
G. TOTAL INVESTMENT (1D-1E-1F)	\$ 997,000

2. ENERGY SAVINGS(+) / COST(-):

DATE OF NISTIR 85-3273X USED FOR DISCOUNT FACTORS **OCTOBER 1992**

ENERGY SOURCE	COST \$/MBTU (1)	SAVINGS MBTU/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	\$ 9.90	\$ 7,440	\$ 73,656	11.19	\$ 825,000
B. DIST					
C. RESID					
D. NG					
E. PPG					
F. COAL					
G. SOLAR					
H. GEOTH					
I. BIOMA					
J. REFUS					
K. WIND					
L. OTHER					
M. DEMAND SAVINGS			\$ 36,090		\$ 405,000
N. TOTAL		\$ 7,440	\$ 109,747		\$ 1,230,000

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$ 91,671

(1) DISCOUNT FACTOR (TABLE A-2) 11.12

(2) DISCOUNTED SAVINGS/COST (3A x 3A1) \$ 1,019,000

B. NON-RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR (3)	DISCOUNTED SAVINGS/COST (+/-) (4)
a. 0	\$ 0	0	\$ 0	0
b.				
c.				
d. TOTAL				

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2 + 3Bd4) \$ 258,000

4. SIMPLE PAYBACK 1G/(2N3 + 3A + 3Bd1/Economic Life): 5.0 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5 + 3C): \$ 2,249,000

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 2.3

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.9%

Economic Life 15 Yrs

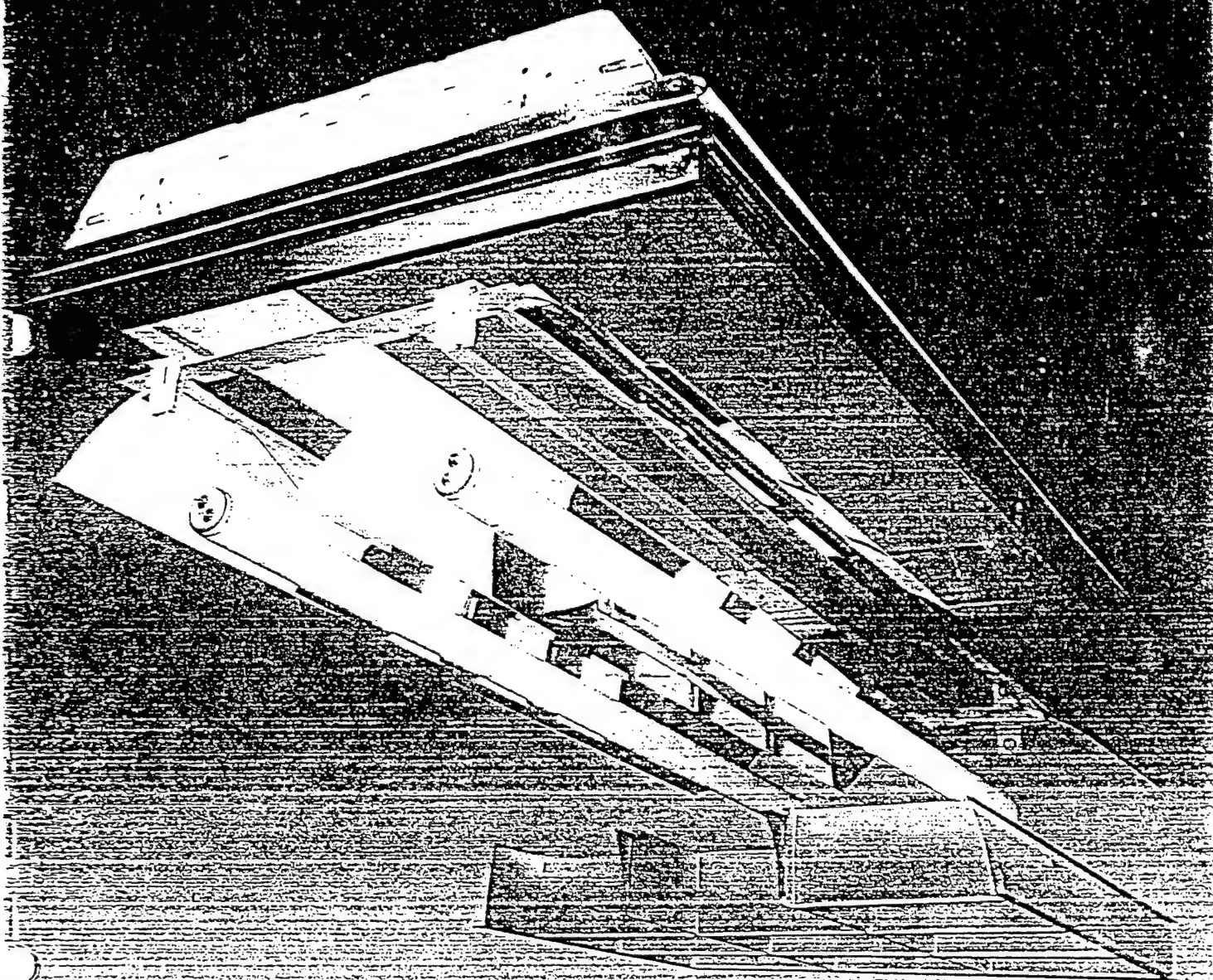
³ Costs are Unescalated

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 220		5. PROJECT NUMBER ECIP #1
<p>SPECIAL REQUIREMENTS PARAGRAPH 3 (SRP-3):</p> <p>Energy Requirements Appraisal (ERA)</p> <p>1. Project Description: Replace existing lighting systems with more efficient lighting systems without reducing the light levels.</p> <p>2. Estimated Energy Consumption: The buildings are currently lit by standard efficiency lighting. Replacing the existing lighting with high efficiency lighting will result in 7,440 MBtu/Yr of electrical energy savings, a fifty-nine percent (59%) reduction in current energy consumption.</p> <p>3. Energy Sources: No new energy sources are required for the proposed project. The use of solar energy for this project is impractical.</p> <p>4. Energy Use Impacts: The proposed project will substantially reduce the consumption of electricity for lighting. The burden on the existing base distribution system will be lessened.</p> <p>5. Energy Conservation: The proposed project will reduce annual energy consumption by 7,440 MBtu/Yr with annual energy cost savings of \$109,747. The project complies with Army Resources Management Plan (ERMP) and Executive Order 12759.</p> <p>6. Energy Alternatives: The proposed project represents the greatest possible reduction in energy consumption without reducing the current lighting levels.</p> <p>7. Energy Effects: The proposed project provides positive environmental effects. It reduces the current energy consumption effectively, reducing the consumption of non-renewable fuel sources. The degrading of environmental standards would not make more efficient energy sources available.</p> <p>8. Basis of Approval: Total energy requirements and alternative fuel sources have been considered and included in this appraisal or discarded as applicable.</p>		

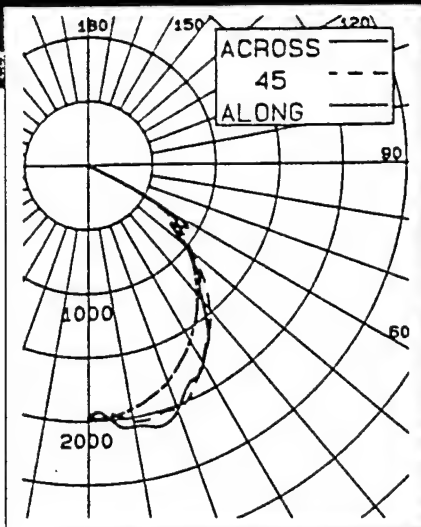
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Parke Powerlite 4 Series



Parke Powerlite 3 Series



The Parke Powerlite is a low profile recessed fixture made of one-piece code gauge steel, die-formed and embossed. This fixture's high light output and high efficiency features a three-piece silver reflector with 94% plus specular reflectivity. The reflector is made of a rigid base metal substrate with silver film attached by a heat activated cross-link adhesive. The silver is protected by an ultra-violet inhibited polyester film and is guaranteed for ten years not to crack, peel or delaminate. The PP3 Series is our most versatile series featuring a variety of lens/louver options, easy access plate that permits wiring without opening the fixture and an excellent space to mounting height. This fixture is available in surface mount or recessed applications.

Model #PP3242ESPS75A 1

CANDLEPOWER SUMMARY

ANGLE	ALONG 22.5	45	67.5	ACROSS	OUTPUT LUMEN
0	1966	1966	1966	1966	
5	1970	1942	1944	1970	188
10	1932	1924	2025	2069	
15	1871	1928	2028	2090	566
20	1799	1891	2021	2027	
25	1694	1842	1930	1899	861
30	1581	1754	1781	1783	
35	1462	1662	1629	1631	1010
40	1317	1520	1474	1431	
45	1169	1358	1284	1198	972
50	1003	1175	1059	1005	
55	822	944	883	812	773
60	671	669	605	668	
65	93	149	118	143	229
70	5	6	5	7	
75	3	6	1	6	5
80	8	4	5	2	
85	8	4	5	2	4
90	0	0	0	0	

#9856 - PARKE POWERLITE 3 SERIES...RECESSED 2x4 LUMINAIR.
MODEL # PP3242ESPS75A1, SILVER REFLECTOR. (2) F40T12/WW
LAMPS, (1) ADVANCE R-2S40-1-TP BALLAST, 3/4 x 3/4 SPECULAR
LOUVER. LUMEN RATING = 3200.

- Code gauge steel
- 4" deep troffer
- 3/4" x 3/4" silver paracube louver
- Energy saver ballast
- (2) F40T12 lamps
- 3-piece specular silver reflector w/tablock fastening
- 2' x 4'
- Designed specifically for computer applications

COEFFICIENTS OF UTILIZATION ZONAL CAVITY METHOD
EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

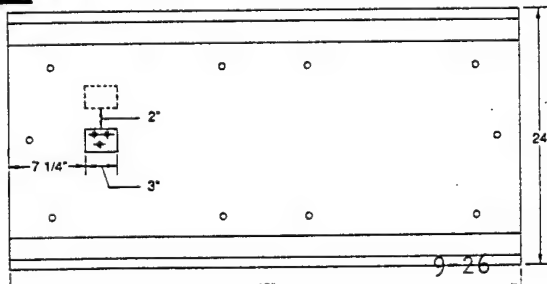
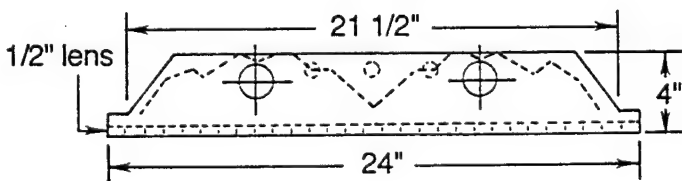
CC WALL	80				70				50				30				10				0
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10				
RCR																					
0	.86	.86	.86	.86	.84	.84	.84	.84	.80	.80	.80	.77	.77	.77	.73	.73	.73	.72			
1	.81	.78	.76	.74	.79	.77	.74	.73	.73	.72	.70	.71	.69	.68	.68	.67	.66	.65			
2	.75	.71	.67	.64	.74	.69	.66	.63	.67	.64	.62	.65	.63	.61	.63	.61	.59	.58			
3	.70	.64	.59	.56	.68	.63	.59	.55	.61	.57	.54	.59	.56	.54	.57	.55	.53	.51			
4	.65	.58	.53	.49	.63	.57	.52	.48	.55	.51	.48	.54	.50	.47	.52	.49	.47	.45			
5	.60	.52	.46	.42	.58	.51	.46	.42	.50	.45	.42	.48	.44	.41	.47	.44	.41	.40			
6	.55	.47	.41	.37	.54	.46	.41	.37	.45	.40	.37	.44	.40	.36	.43	.39	.36	.35			
7	.51	.42	.37	.33	.50	.42	.36	.32	.41	.36	.32	.39	.35	.32	.39	.35	.32	.30			
8	.47	.38	.32	.28	.46	.37	.32	.28	.36	.32	.28	.36	.31	.28	.35	.31	.28	.26			
9	.43	.34	.28	.25	.42	.34	.28	.25	.33	.28	.24	.32	.27	.24	.31	.27	.24	.23			
10	.40	.31	.25	.22	.39	.30	.25	.22	.30	.25	.22	.29	.25	.21	.29	.24	.21	.20			

83.1 Watts

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	1615	25.24	35.05
0-40	2625	41.03	56.97
0-60	4371	68.30	94.84
0-90	4609	72.02	100.00
40-90	1983	30.99	43.03
60-90	237	3.71	5.16
90-180	0	.00	.00
0-180	4609	72.02	100.00

**** EFFICIENCY = 72.0% ****

$$S/MH = 1.3$$
$$SC(Along) = 1.2$$
$$SC(ACROSS) = 1.3$$


Model #PP4242ESDC12B1

#7568 - PARKE POWERLITE 4 SERIES
RECESSED 2X4 LUMINAIRE, MODEL
#PP4242ESDC12B1 SILVER REFLECTOR, (2)
F40T12/WW LAMPS, (1) ADVANCE R - 25-40
BALLAST, 12 - CELL SEMI - SPECULAR 3"
DEEP LOUVER, LUMEN RATING - 3150.

- Code gauge steel
- 6" deep reflector
- 3" 12 - cell semi - specular parabolic luminaire
- Energy saving ballast
- (2) F40T12 lamps
- 3 - piece specular silver reflector with tablock fastening
- 2X4"

Model #PP4242OEDC12B1

#9655 - PARKE POWERLITE 4 SERIES, RECESSED
2X4 LUMINAIRE, MODEL #PP4242OEDC12B1,
SILVER REFLECTOR, (2) GE F32SP41 32,
WATT TR LAMPS, (1) TRIAD B33H120 ELEC.
TRONIC BALLAST, 12 - CELL SEMI - SPECULAR
3" DEEP LOUVER, LUMEN RATING - 2750

- Code gauge steel
- 3" 12 - cell semi - specular parabolic luminaire
- Electronic ballast
- (2) T8 lamps
- 3 - piece specular silver reflector with tablock fastening
- 2X4"

Model #PP4222BXDC09B1

#1918A - PARKE POWERLITE 4 SERIES, 2X2
LUMINAIRE, MODEL #PP4222BXDC09B1,
SILVER REFLECTOR, (2) GE F0408 XSPX15K5,
1 BALLAST, 9 - CELL SEMI - SPECULAR 3"
DEEP LOUVER, LUMEN RATING - 3150.

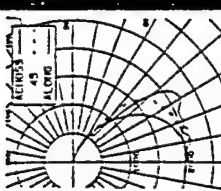
- Code gauge steel
- 3" 9 - cell semi - specular luminaire
- Blast magnetic ballast
- (2) F40 BX lamps
- 3 - piece specular silver reflector with tablock fastening
- 2X2"

PARKE INDUSTRIES INC.

CC	WALL	80	70	60	50	40	30	20	10	0
0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
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3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10

CC	WALL	80	70	60	50	40	30	20	10	0
0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
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8	8	8	8	8	8	8	8	8	8	8
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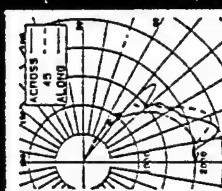
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3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9
10	10	10	10	10	10



CC	WALL	80	70	60	50	40	30	20	10	0
0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4
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9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10

CC	WALL	80	70	60	50	40	30	20	10	0
0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
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10	10	10	10	10	10	10	10	10	10	10

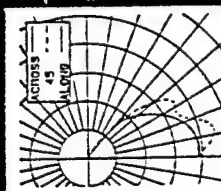
ANGLE ALONG	215	45	67.5	ACROSS	OUTPUT
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2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
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6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9
10	10	10	10	10	10



CC	WALL	80	70	60	50	40	30	20	10	0
0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
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9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10

CC	WALL	80	70	60	50	40	30	20	10	0
0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
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9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10

ANGLE ALONG	215	45	67.5	ACROSS	OUTPUT
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9
10	10	10	10	10	10



FOOTCANDLE AND ENERGY SELECTOR

SQ. FT. PER. FIX.	1	2	3	4	RCR 5	6	7	8	9	10	WATTS PER SQ. FT.
16	255	232	209	190	171	155	142	129	116	106	5.30
24	170	155	139	127	114	103	94	86	77	71	3.53
25	163	148	134	121	109	99	90	82	74	68	3.39
32	127	116	104	95	85	77	71	64	58	53	2.65
36	113	103	93	84	76	68	63	57	51	47	2.35
40	102	93	83	76	68	62	56	51	46	42	2.12
48	85	77	69	63	57	51	47	43	38	35	1.76
50	81	74	67	60	54	49	45	41	37	34	1.69
60	68	62	55	50	45	41	37	34	31	28	1.41
64	63	58	52	47	42	38	35	32	29	26	1.32
72	56	51	46	42	38	34	31	28	25	23	1.17
80	51	46	41	38	34	31	28	25	23	21	1.06
96	42	38	34	31	28	25	23	21	19	17	0.88
100	40	37	33	30	27	24	22	20	18	17	0.84
120	34	31	27	25	22	20	18	17	15	14	0.70

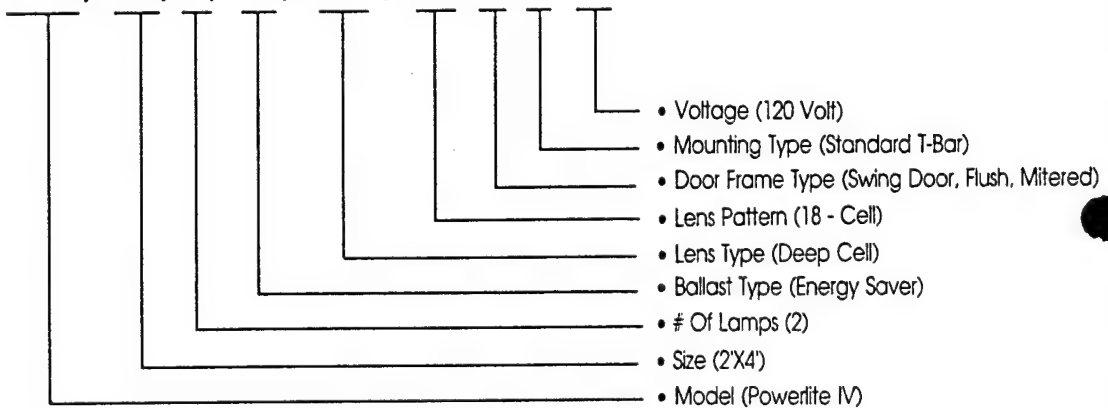
CRITERIA:

1. ILLUMINATION, TOTAL AREA COVERAGE
2. BASED ON PHOTOMETRIC REPORT, LS19864
3. REFLECTANCE, 80-50-20
4. NUMBER OF LAMPS, 2
5. LUMENS PER LAMP, 3200
6. WATTS PER FIXTURE, 84.9
7. MAINTENANCE FACTOR(LLF), .85
8. BALLAST FACTOR, .95.

Ordering Guidelines

Example: PP4/24/2/ES/DC/18/B/1/1

When ordering the Parke Powerlite, the guidelines show the luminaire's type and specifications, therefore, all fifteen (15) characters of the fixture code must appear on the Purchase Order (P.O.) to ensure proper ordering.



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INDUSTRIES
INC.**

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2246 Lindsay Way
Glendora, CA 91740
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FAX: (714) 599-1208

Rocky Mountain Division
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Louisville Superior, CO 80027
Tel: (303) 494-2659
FAX: (303) 494-2659

Midwest Division
5030 West Lawrence Avenue
Chicago, IL 60630
Tel: (312) 794-0404
FAX: (312) 286-0411

Northwest Division
1139 Grandview Drive
South San Francisco, CA 94080
Tel: (415) 742-6390
FAX: (415) 742-6432

Southeast Division
2819 Devine Street, Suite 201
Columbia, SC 29205
Tel: (803) 776-4529
FAX: (803) 695-0510

Parke Industries of Canada
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Sardis, British Columbia
Canada V2R 1B1
Tel: (604) 858-0666
FAX: (604) 858-0410



Underwriters Laboratories Inc.

FLUORESCENT FIXTURE ISSUE #C-44.690
RECESSED FLUORESCENT FIXTURE ISSUE #A-521-180
RECESSED FLUORESCENT FIXTURE ISSUE #A-521-172
FIXTURE CONVERSION REFLECTOR KIT CLASSIFIED BY UNDERWRITERS LABORATORIES, INC. E11269

Due to our continuing efforts to manufacture the best product, design and specifications are subject to change without notice. Please consult the factory for fixture options.



MOTOROLA
Lighting Inc.



3 LAMPS
INPUT:
120 VOLTS AC 60 Hz



MOTOROLA
Lighting Inc.

ELECTRONIC BALLAST RAPID START
MODEL NO. M3-RN-T12-11L-120
FOR SERVICE: 1-800-343-2089
BUFFALO GROVE, IL 60089
NO PCB'S



DISCONNECT POWER WHEN SERVICING



MOTOROLA
Lighting Inc.

ELECTRONIC BALLAST RAPID START
MODEL NO. M3-RN-T12-11L-127
FOR SERVICE: 1-800-343-2089
BUFFALO GROVE, IL 60089
NO PCB'S



DISCONNECT POWER WHEN SERVICING

CLASS P HIGH POWER FACTOR
LAMP TYPE: F30T8, F30T5, F30T4, F30T3, F30T2, F30T1, F30T0
SOUND RATING: 100 dB
STARTING TEMP: 50°F
INSTALL IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES

**HIGH PERFORMANCE
ELECTRONIC BALLASTS**

**FLUORESCENT 1, 2, 3 and 4 LAMP
RAPID START**

MOTOROLA

Lighting Inc.

Total Customer Satisfaction

CUSTOMER SUPPORT
1-800-MLI-0089

HIGH PERFORMANCE FEATURES

Power Factor:	Greater than .99
Total Harmonic Distortion:	Less than 10%
Third Harmonic Distortion:	Less than 6%
<hr/>	
Lamp Current Crest Factor:	Less than 1.5
Lamp Current Frequency:	Greater than 25 KHz
Lamp Configuration:	Series
Lamp Flicker:	Less than 2%, Not Visible
<hr/>	
Sound Rating:	Class A
Projected Life:	20 years plus
Connector:	Poke-in wire trap for 18 gauge (solid wire)
Weight:	1.2 lbs.
EMI:	Meets FCC Part 18, Subpart C

CODES

UL Listed: Class P
Transient Protection: Meets ANSI C62.41, Cat. A
(Formerly IEEE 587)

WIRETRAP CONNECTOR

OUR UNIQUE POKE-IN
CONNECTORS SIMPLIFY INSTALLATION
AND SAVE TIME.



PART NUMBER DESCRIPTION

MODEL NUMBER	DESCRIPTION
M42	Model Number
R	Recessed
N	Normal
T8	T8 Lamp
1LL	1 Light Level
277	277 Volt Light Output

120

QUALITY

Motorola's goal of acceptable quality is at Six Sigma or no more than 3.4 defects per million opportunities. Motorola Lighting Inc. designed its electronic ballast to meet the most rigorous performance standards at world class levels. This translates into a highly robust product that goes through extensive environmental stress testing to assure our customers of very low initial defect levels (less than 0.1%) and high reliability (greater than 500,000 hours Mean Time to Failure—MTTF).

The economic ballast life is 20 years when operated at 45°C ambient temperature. Operation of MLI's ballast at 50°C may derate life expectancy by 25%.

Six Sigma Quality means "world class" in all that we do at Motorola Lighting Inc., which is part of our commitment to TOTAL CUSTOMER SATISFACTION.



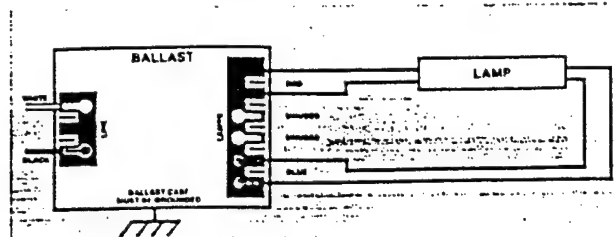
RAPID START BALLASTS

Lamp Type	Rated Lamp Wattage (W)	Lamp Length (FT)	Model No.	Line Voltage (V)	Max Line Current (A)	Typical Line Current (A)	Typical Input Power (W)		Min. Starting Temp (F)
							Open	Enclosed	
1 LAMP T8									
F32T8	32	4	M1-RN-T8-1LL-120	120	.31	.24	29	28	50°
F32T8	32	4	M1-RN-T8-1LL-277	277	.13	.11	29	28	50°
F25T8	25	3	M1-RN-T8-1LL-120	120	.24	.19	23	22	50°
F25T8	25	3	M1-RN-T8-1LL-277	277	.10	.08	23	22	50°
F17T8	17	2	M1-RN-T8-1LL-120	120	.17	.13	16	15	50°
F17T8	17	2	M1-RN-T8-1LL-277	277	.07	.08	16	15	50°
2 LAMP T8									
F32T8	32	4	M2-RN-T8-1LL-120	120	.55	.51	61	58	50°
F32T8	32	4	M2-RN-T8-1LL-277	277	.24	.21	59	56	50°
F25T8	25	3	M2-RN-T8-1LL-120	120	.42	.40	48	45	50°
F25T8	25	3	M2-RN-T8-1LL-277	277	.18	.17	46	44	50°
F17T8	17	2	M2-RN-T8-1LL-120	120	.27	.24	32	29	50°
F17T8	17	2	M2-RN-T8-1LL-277	277	.12	.10	34	31	50°
2 LAMP T12									
F40T12	40	4	M2-RN-T12-1LL-120	120	.64	.59	71	69	50°
F40T12	40	4	M2-RN-T12-1LL-277	277	.27	.25	69	67	50°
F40T12	34	4	M2-RN-T12-1LL-120	120	.54	.50	60	59	60°
F40T12	34	4	M2-RN-T12-1LL-277	277	.23	.21	58	57	60°
F40T10	40	4	M2-RN-T12-1LL-120	120	.64	.60	72	71	50°
F40T10	40	4	M2-RN-T12-1LL-277	277	.27	.25	70	69	50°
F30T12	30	3	M2-RN-T12-1LL-120	120	.48	.44	53	52	50°
F30T12	30	3	M2-RN-T12-1LL-277	277	.21	.19	52	50	50°
F30T12	25	3	M2-RN-T12-1LL-120	120	.40	.37	44	43	60°
F30T12	25	3	M2-RN-T12-1LL-277	277	.17	.16	43	42	60°
3 LAMP T8									
F32T8	32	4	M3-RN-T8-1LL-120	120	.78	.76	90	87	50°
F32T8	32	4	M3-RN-T8-1LL-277	277	.33	.32	89	85	50°
F25T8	25	3	M3-RN-T8-1LL-120	120	.61	.59	70	67	50°
F25T8	25	3	M3-RN-T8-1LL-277	277	.26	.25	69	66	50°
F17T8	17	2	M3-RN-T8-1LL-120	120	.39	.35	47	44	50°
F17T8	17	2	M3-RN-T8-1LL-277	277	.16	.14	44	41	50°
3 LAMP T12									
F40T12	40	4	M3-RN-T12-1LL-120	120	.92	.90	107	105	50°
F40T12	40	4	M3-RN-T12-1LL-277	277	.45	.38	105	103	50°
F40T12	34	4	M3-RN-T12-1LL-120	120	.84	.77	91	89	60°
F40T12	34	4	M3-RN-T12-1LL-277	277	.41	.33	90	88	60°
F40T10	40	4	M3-RN-T12-1LL-120	120	.99	.92	109	107	50°
F40T10	40	4	M3-RN-T12-1LL-277	277	.48	.39	107	105	50°
F30T12	30	3	M3-RN-T12-1LL-120	120	.76	.67	80	78	50°
F30T12	30	3	M3-RN-T12-1LL-277	277	.37	.29	78	76	50°
F30T12	25	3	M3-RN-T12-1LL-120	120	.71	.57	67	65	60°
F30T12	25	3	M3-RN-T12-1LL-277	277	.35	.24	66	64	60°
4 LAMP T8									
F32T8	32	4	M4-RN-T8-1LL-120	120	1.04	1.02	121	118	50°
F32T8	32	4	M4-RN-T8-1LL-277	277	.44	.43	118	115	50°
F25T8	25	3	M4-RN-T8-1LL-120	120	.81	.80	95	91	50°
F25T8	25	3	M4-RN-T8-1LL-277	277	.35	.34	93	90	50°
F17T8	17	2	M4-RN-T8-1LL-120	120	.55	.49	67	64	50°
F17T8	17	2	M4-RN-T8-1LL-277	277	.22	.19	61	58	50°

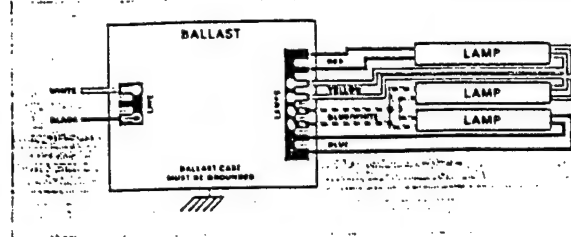
Ballast Will Operate the U-Shaped Equivalents of the Above Lamps. Test Data from Independent Test Lab Available on Request from Factory.

WIRING DIAGRAMS AND BALLAST DIMENSIONS

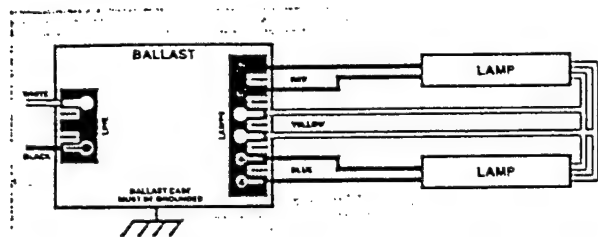
WIRING DIAGRAMS



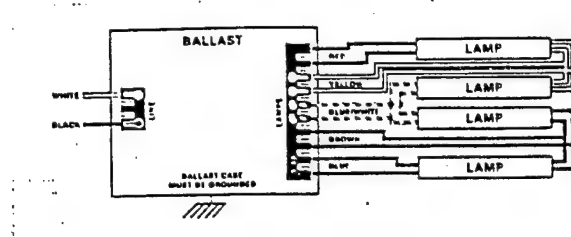
1 LAMP



3 LAMP

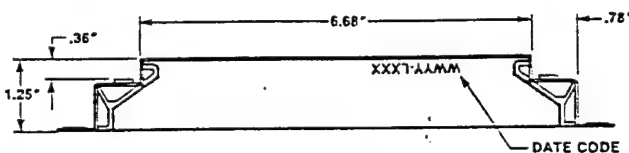
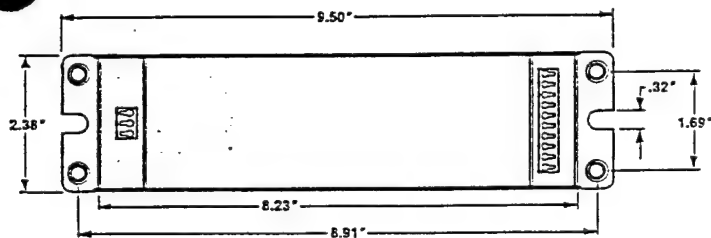


2 LAMP



4 LAMP

BALLAST DIMENSIONS*



*BALLAST IS SYMMETRICAL FOR MOUNTING PURPOSES



Our state-of-the-art manufacturing facility in Buffalo Grove, Illinois—in the U.S.A.

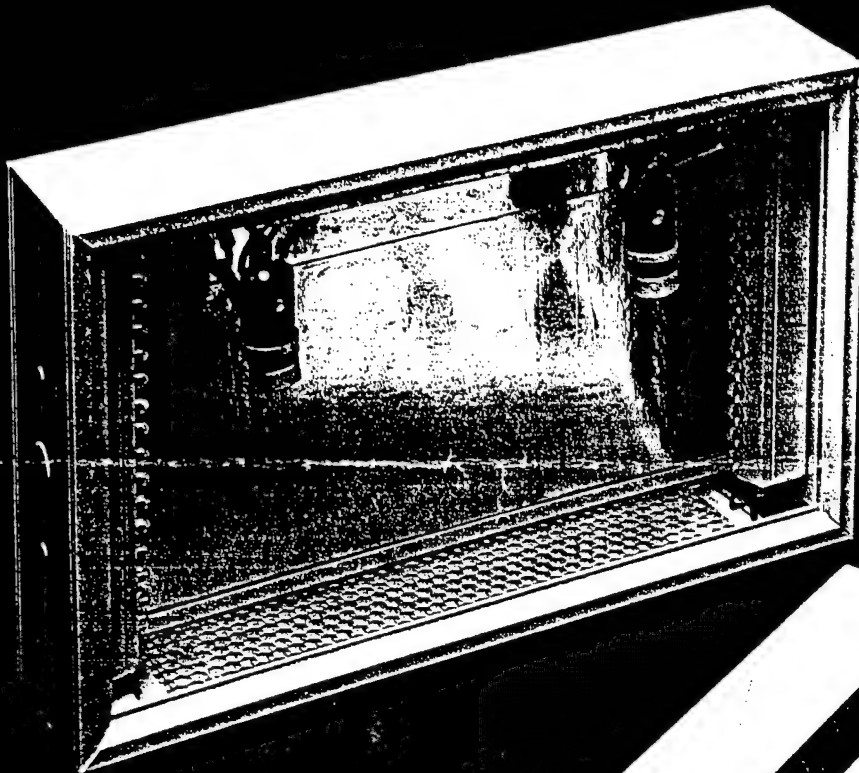


MOTOROLA
Lighting Inc.

867 Deerfield Parkway
Buffalo Grove, IL 60089
1-800-MLI-0089

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EXIT

After more than 25 years of supplying quality emergency lighting products to fixtures manufacturers, AstraLite® has designed a revolutionary new light source which we couldn't pass up offering directly to you through distribution — the AstraLite 2000.

Our new technology provides an innovative way to upgrade your existing exit signs using light-emitting diodes (LEDs). The AstraLite 2000 reduces energy costs by up to 96% and can pay for itself in about six months — then, pump cash flow into

your bottom line for its remaining 80-100 years of virtually maintenance-free operation. Most importantly, you gain peace of mind that the continuously lighted word EXIT ensures safety during an emergency — and compliance with codes, fire marshals, insurance companies and the public.

AstraLite is ready to help you virtually eliminate the energy and maintenance costs and hassles associated with keeping your exit signs lighted. To learn more about the numerous benefits of upgrading your exit signs, call (800) 832-LITE.

Comparison Chart 1 year	Light Source Life	Annualized Product Replacement Cost	Annual Energy Cost ¹	Annual Maintenance Cost ²
Incandescent (Two 20-watt bulbs)	3,000 hrs.	\$16.06 ³	\$35.04	\$24.33
Compact fluorescent (One 9-watt bulb with 3-watt ballast adapter)	10,000 hrs	\$10.00 ⁴	\$10.51	\$8.33
AstraLite 2000 (1.8-watt unit)	80-100 yrs. (700,800-876,000 hrs.)	\$0.00	\$1.58	\$0.00

¹ Based on utility kilowatt-hour rate of 10c.

² Based on 25 minutes to replace bulb(s) at \$20.00 per hour.

³ Based on bulb cost of \$2.75.

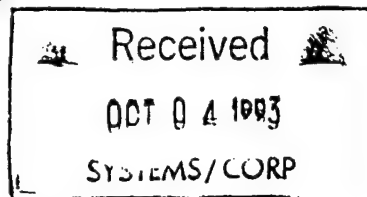
⁴ Based on one replacement per year plus ballast replacement every three years.



Astralite
PO Box 476 Annandale, NJ 08801-0476
(800) 832-LITE (908) 735-0232
Patent Applied

River City Reflector Company

1043 South Cooper Street
Memphis, Tennessee 38104
(901) 274-8200



PRICE LIST 9/1/93

ASTRALITE LED EXIT RETROFIT KITS

SINGLE FACE	120V	With Socket Adapters *	39.95 ea
DOUBLE FACE	120V	With Socket Adapters *	59.95 ea

* SPECIFY SOCKET TYPE: (MED, D.C., INTERMEDIATE, CANDELABRA)

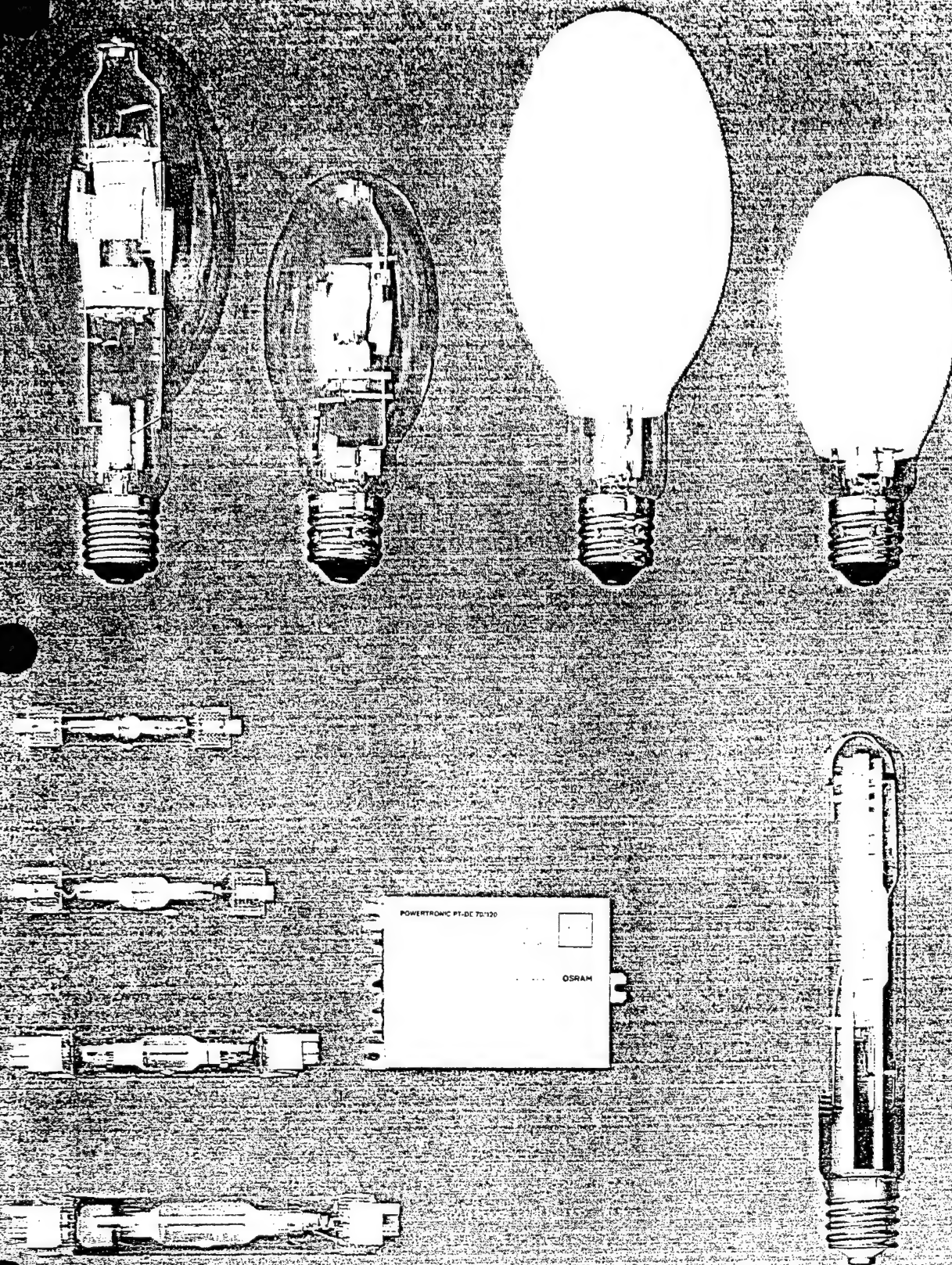
SINGLE FACE	120V	Direct Wire/Snap-Connect	36.95 ea
DOUBLE FACE	120V	Direct Wire/Snap-Connect	56.95 ea

SINGLE FACE	277V	AVAILABLE IN DIRECT WIRE ONLY	42.95 ea
DOUBLE FACE	277V	AVAILABLE IN DIRECT WIRE ONLY	56.95 ea

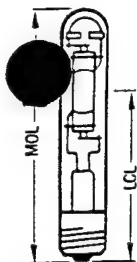
REPLACEMENT DIFFUSER (IF NECESSARY) 8.00 EA
(BRIGHT RED)

1. Kits contain LED light sticks, 2 quick-connect socket adapters, or Direct Wire Snap-Connectors, Reflective adhesive tape, and wire ties.
2. Minimum Order 12 kits. Adapter types can be mixed.
3. Terms 1% 10, Net 30
4. Freight allowed on orders of \$ 1500 or more
5. Deduct 5% from price listed above on Purchases of 96 or more units.

Metal Halide Lamps



Metal Halide Lamps



Mogul Base HQI Metal Halide Lamps (Refer to page 37, Notes 1, 7, 8)

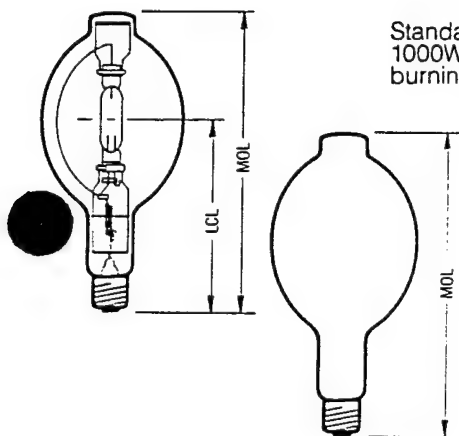
Watts	Bulb	Base	ANSI Code	Product Order Code	Reference	Pkg. Qty.	Color Temperature	Color Rendering C.R.I.	Service Life Hrs.	Approx. Initial Lumens	MOL Inches (mm)	LCL Inches (mm)
250	T14 1/2	MOG	M80	HR010	HQI-SE250/DX*	12	5400K	90	9,000	19,000	8 5/8 (220)	5 7/8 (150)
400	T14 1/2	MOG	S51	HR030	HQI-SE400/DX*	12	5400K	90	9,000	33,000	9 7/8 (250)	5 3/4 (146)

* Universal burning position.

STANDARD METAL HALIDE LAMPS (Refer to page 37, Notes 1, 7)

With a color rendition of C.R.I. 65, standard metal halide lamps fulfill the requirements for industrial, warehouse and street lighting where a lower C.R.I. is acceptable.

Standard metal halide lamps are available in a full range of wattages from 175W to 1000W, both clear and coated. They are made in U.S.A. and designed for universal burning position.



Watts	Bulb	Base	ANSI Code	Product Order Code	Reference	Pkg. Qty.	Description	Color Rendering C.R.I.	Avg. Rated Hrs. Life	Approx. Initial Lumens	Burning Position	MOL Inches	LCL Inches
175	BT28	MOG	M57	HQ300	MH175/U	12	Clear, 4300K	65	10,000	14,000	Universal	8 1/4	5
			M57	HQ305	MH175/C/U	12	Coated, 4100K	70	10,000	14,000	Universal	8 1/4	5
250	BT28	MOG	M58	HR300	MH250/U	12	Clear, 4300K	65	10,000	20,500	Universal	8 1/4	5
			M58	HR305	MH250/C/U	12	Coated, 3900K	70	10,000	20,500	Universal	8 1/4	5
400	BT37	MOG	M59	HR310	MH400/U	6	Clear, 4000K	65	20,000	36,000	Universal	11 5/16	7
			M59	HR315	MH400/C/U	6	Coated, 3700K	70	20,000	36,000	Universal	11 5/16	7
1000	BT56	MOG	M47	HS300	MH1000/U	6	Clear, 3900K	65	12,000	110,000	Universal	15 3/8	9 1/2
			M47	HS305	MH1000/C/U	6	Coated, 3400K	70	12,000	105,000	Universal	15 3/8	9 1/2

Note:

All lamps listed on this page can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available.

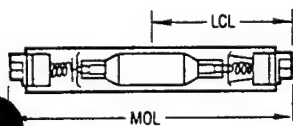
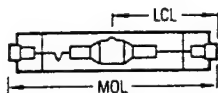
OSRAM HQI® METAL HALIDE LAMPS WITH HIGH C.R.I.

OSRAM HQI lamps have set a new standard in metal halide lamps with C.R.I. of up to 93. They feature high luminous efficacy and excellent color rendering properties.

OSRAM HQI lamps are available with single-ended or double-ended base in 3000K, 4200K and 5400K light color.

With design wattages from 70W to 1000W, OSRAM HQI lamps provide a wide variety of lumen packages for display lighting, illumination of stores, offices and commercial buildings in both indoor and outdoor applications.

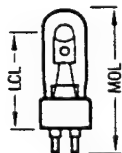
- outstanding color rendition of up to C.R.I. 93
- designed with a small tubular envelope and a compact arc stream for operation in highly efficient reflector systems.
- long service life
- high lumen output
- HQI-DE 70W can also be used with POWERTRONIC (refer to page 33)



Double-Ended HQI Compact Metal Halide Lamps (Refer to page 37, Notes 1, 6, 7)

Watts	Bulb	Base	ANSI Code	Product Order Code	Reference	Pkg. Qty.	Color Temperature	Color Rendering C.R.I.	Service Life Hrs.	Approx. Initial Lumens	MOL Inches (mm)	LCL Inches (mm)
70	T6 1/2	RSC	M85	HQ050	HQI-DE70/WDX*	12	3000K	81	10,000	5,000	4 1/2 (114)	2 1/4 (57)
			M85	HQ040	HQI-DE70/NDX*	12	4200K	85	10,000	5,500	4 1/2 (114)	2 1/4 (57)
150	T7 1/2	RSC	M81	HQ055	HQI-DE150/WDX*	12	3000K	81	10,000	11,000	5 3/16 (132)	2 5/8 (65)
			M81	HQ060	HQI-DE150/NDX*	12	4200K	85	10,000	11,250	5 3/16 (132)	2 5/8 (65)
250	T9 1/2	RSC	M80	HR085	HQI-DE250/NDX*	12	4200K	85	10,000	20,000	6 1/2 (165)	3 1/4 (82)
		Fc2	M80	HR080	HQI-DE250/NDX*	12	4200K	85	10,000	20,000	6 7/16 (163)	3 3/16 (81)
			M80	HR070	HQI-DE250/DX*	12	5400K	93	10,000	19,000	6 7/16 (163)	3 3/16 (81)
400	T10	Fc2	M86	HR090	HQI-DE400/DX*	12	5400K	93	10,000	33,000	8 1/8 (206)	4 1/16 (103)

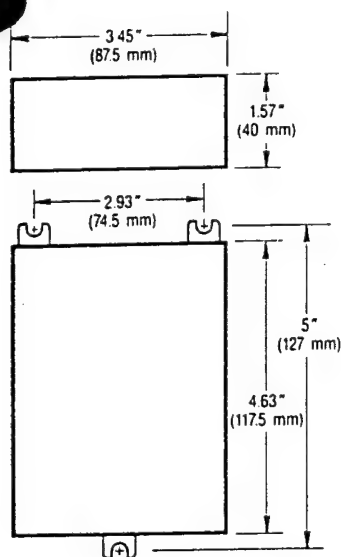
* Burning Position: HOR $\pm 45^\circ$



Single-Ended HQI Compact Metal Halide Lamps (Refer to page 37, Notes 1, 6, 7)

Watts	Bulb	Base	ANSI Code	Product Order Code	Reference	Pkg. Qty.	Color Temperature	Color Rendering C.R.I.	Service Life Hrs.	Approx. Initial Lumens	MOL Inches (mm)	LCL Inches (mm)
70	T8	G12	M85	HQ035	HQI-SE70/WDX*	12	3000K	81	6,000	5,200	3 5/16 (84)	2 3/16 (56)
150	T8	G12	M81	HQ061	HQI-SE150/WDX*	12	3000K	81	6,000	12,000	3 5/16 (84)	2 3/16 (56)

* Universal burning position.



POWERTRONIC™ — ELECTRONIC REGULATING BALLAST FOR HID LAMPS

The POWERTRONIC is a single electronic unit containing a ballast, ignitor, and phase correcting circuitry. It is designed for use with OSRAM HQI-DE and LU-DE lamps. By utilizing smart electronics, POWERTRONIC senses both line fluctuation and lamp aging which results in high quality illumination and constant lamp wattage to extend lamp life.

The compact size and its light weight makes POWERTRONIC ideal for applications in retail and display lighting.

FEATURES:

- compact, lightweight fully integrated ballast
- power load reduced by 13%
- high power factor > .9
- constant wattage regulation 95V-135V line voltage
- increased lamp life
- stabilized lamp color
- safety starter with automatic shut-off
- U.L. listed product

Model	Product Order Code	Volts	For Lamp Type	Length inches (mm)	Width inches (mm)	Height inches (mm)
PT-DE 70/120	PT 100	120	HQI-DE 70/WDX	4.63 (117.5)	3.45 (87.5)	1.57 (40)
	PT 100	120	HQI-DE 70/NDX	4.63 (117.5)	3.45 (87.5)	1.57 (40)
	PT 100	120	LU-DE 70	4.63 (117.5)	3.45 (87.5)	1.57 (40)

TECHNICAL DATA

Model:	PT-DE 70/120
Number of Lamps:	1
Lamp Type:	OSRAM HQI-DE 70/WDX, OSRAM HQI-DE 70/NDX, OSRAM LU-DE 70
Line Voltage:	120VAC (50-60 Hz)
Operating Voltage Range:	Continuous: 95 VAC to 135 VAC; Short Term: 90 VAC to 150 VAC
Power Factor:	> .9
Input Current:	.69A
Input Wattage:	80W
Line Current Harmonics:	8% Total Harmonic Distortion
Transient Protection:	Meets ANSI C62.41
Electromagnetic Interference:	Meets FCC Part 18C
UL Approved:	U.L. Listed Product
Internal Safety Starter:	Internal Starter with automatic turn-off
Thermal Shut Down:	POWERTRONIC will automatically shut down if case temperature exceeds 85°C/185°F
Lamp Ballast Separation:	Ballast may be removed from the lamp up to 10 feet (3 meters)

TE

Use in high bay areas requiring dirt or moisture protection.

Catalog Number

TE 70S E17

M

Example: TE 70S E17 M 120

120

HIGH PRESSURE SODIUM				HIGH PRESSURE SODIUM				VOLTAGE		Options	
Designation				Distribution (Select One)				Voltage			
70W	TE	70S	E17	N	C	M	S	W	120	For options and accessories, see pages 246-252.	
100W	TE	100S	E17	N	C	M	S	W	208		
150W	TE	150S	E17	N	C	M	S	W	240		
200W	TE	200S	E17	N	C	M	S	W	277		
250W	TE	250S	E17	-	C	M	S	W	347		
400W	TE	400S	E17	-	-	M	S	W	480		
400W	TE	400S	E22	N	C	-	-	-	TB ¹		
1000W	TE	1000S	E22	N	C	-	-	-			

Features

Housing: Rugged, heavy-duty, die-cast aluminum with dark bronze polyester powder finish. Electrical components are opposed horizontally and heat sinked to ballast housing for cooler operation.

Ballast: Copper wound and 100% factory tested. Encased and potted, solid state ignitors (HPS). High power factor. Constant wattage autotransformer. 180°C Class H insulation system. UL 1029 listed.

One-piece totally enclosed and gas-tight Arc Tek II™ spun aluminum, anodized reflector combines high efficiency with extended shielding angle for high performance optical control. Exclusive fluting design minimizes arc tube voltage rise. Gasketed clear tempered glass lens inhibits the entrance of ambient contaminants. Stainless steel hinge and lens retainer latches facilitate lamp access without tools.

Installation: Pendant splice box threaded for 3/4" conduit (standard). Complete line of mounting options and accessories available.

Listing: UL 1572 listed for damp locations and -30°C to 55°C ambient operation. 65°C available. UL wet location label available. CSA certified.

Socket: Porcelain, vertically oriented mogul base socket with copper alloy nickel-plated screw shell and center contact. UL listed 1500W, 600V, 4 KV pulse rated. 5KV pulse rated for 1000S.

N = Narrow
C = Concentrating
M = Medium
S = Spread
W = Widespread

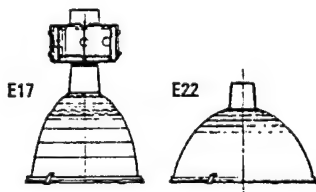
Lamp/Fixture Data

Wattage	Ballast	Weight		Spacing/Mounting Height							
		Lbs.	Kg.	E17M	E17C	E17S	E17W	E22M	E22N	E22C	E22S
HIGH PRESSURE SODIUM (Mog/Clear)											
70	HX-HPF	21	10	1.3	-	-	-	-	-	-	-
100		21	10	1.3	-	-	-	-	-	-	-
150		21	10	1.3	-	-	-	-	-	-	-
200		22	10	1.4	-	-	-	-	-	-	-
250		26	12	1.4	-	-	-	-	-	-	-
400	CWA	41	19	-	-	-	-	-	0.8	1.1	-
400		39	18	1.3	-	1.5	1.9	-	-	-	-
1000		65	29	-	-	-	-	-	0.8	1.0	-
METAL HALIDE (Mog/Clear)											
175	CWA	22	10	1.4	1.0	1.6	-	-	-	-	-
250		24	11	1.9	2.0	-	-	-	-	-	-
400		31	14	1.3	-	1.5	2.0	-	0.8	1.0	-
1000		50	23	-	-	-	-	1.3	-	1.1	1.6
MERCURY VAPOR (Mog/Coated)											
175	CWA	19	9	1.3	-	-	-	-	-	-	-
250		21	10	1.3	-	-	-	-	-	-	-
400		27	12	-	-	1.6	1.8	-	0.8	1.0	-
400		25	11	1.3	-	-	-	-	-	-	-
1000		41	19	-	-	-	-	1.2	-	1.0	-

Lamps available with luminaires. Consult Factory.

¹ Optional Multi-tap Ballast (120, 208, 240, 277V).

CANADIAN SHIPMENTS: Add CSA as suffix to catalog number.



DIMENSIONS

Overall Height	E17: 24 3/8" (61.9 cm) E22: 24 3/8" (62.9 cm)
Reflector Height	E17: 17 3/8" (44.1 cm) E22: 17 3/8" (44.1 cm)
Diameter	E17: 18 3/8" (46.7 cm) E22: 23 3/8" (59.4 cm)

LITHONIA LIGHTING
9-39

facility

LIGHTING IMPROVEMENTS IN BUILDING 350

Rock Island Arsenal, Illinois

project coordinator for using service

David Osborn

functional requirements summary, PDB-1

10-1

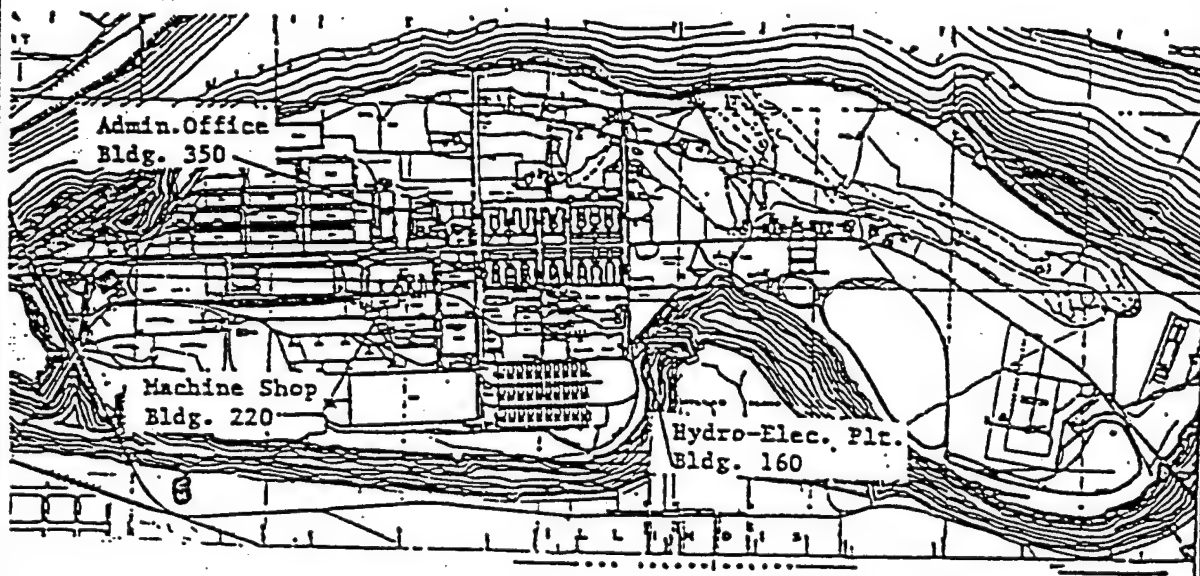
OBJECTIVE:

The objective of this project is to replace existing interior lighting with higher efficiency fixtures and lamps. The replacement of the existing lighting will reduce energy consumption and life cycle operating costs for the subject facilities in accordance with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759.

facilities requirements sketch, PDB- 1/2

10-2

U. S. ARMY
ROCK ISLAND ARSENAL, ILLINOIS



facilities requirements sketch, PDB- 1/2

10-3

APPENDIX C
DOCUMENTATION CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM

ITEM	Required or Not Required	To Be Determined	Comment Attached	Document Attached
A-1 Cost estimates for each primary and supporting facility	NR			
A-2 Telecommunications system coordination with USACC and authorization for exceptions	NR			
A-3 Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse coordination, etc.)	R	A		
A-4 Assignment of airspace	NR			
A-5 Economic analysis of alternatives	R	D		
A-6 Approval for new starts	NR			
A-7 International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)	NR			
A-8 Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	R	A		
A-9 Exceptions to established criteria	NR			
A-10 Coordination with various staff agencies (Provost Marshal-physical security, etc.)	R			
A-11 Identification of related or support projects (so projects can be coordinated)	R			
A-12 Required completion date	R			
Other Special Considerations (List and number items)				

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*** BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

10-5

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Consultation with the District Office to determine and evaluate flood plain hazards	NR			
B-2	Preparation, submission, and/or approval of new	NR			
(A)	General Site Plan	NR			
(B)	Annotated General Site Plan	NR			
(C)	Sketch Site Plan	NR			
(D)	Facilities Requirements Sketch	NR			
B-3	Preparation of	NR			
(A)	Site Survey	NR			
(B)	Subsoil information	NR			
B-4	Approval by Department of Defense Explosive Safety Board (DDESB) for Safety Site Plan	NR			
Other Site Development Considerations (List and number items)					
1. See Project Development Brochure, PDB-1/2					

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E — Other (Check Comments Attached and explain)

documentation checklist

10-6

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	R	D		1
C-3	Approval for removal and relocation of existing usable facilities	NR			
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with installation where sited	NR			
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item B-4)	NR			
C-18	Analysis of deficiencies	R	D		1
C-19	Consideration of alternatives	R	D		2
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-built drawings for alterations or additions	R	C		
C-22	Availability of Standard Design or site adaptable designs	NR			
Other Architectural & Structural (List and number items)					
1. See Supplemental Data Detailed Project Justification Paragraph D3.					
2. See Supplemental Data Detailed Project Justification Paragraph D4.					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

10-7

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
D-1	Fuel considerations and cost comparison analysis	R	D		
D-2	Energy requirements appraisal (ERA)	R	D		1
D-3	Conformance with DOD Energy Reduction requirements	R	D		
D-4	Evaluation of existing and/or proposed utility systems	R	D		
Other Mechanical and Utility Systems (List and number items)					
1. See Special Requirements, Paragraph 3 (SRP-3)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

10-8

E. ENVIRONMENTAL CONSIDERATIONS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
E-1	Environmental impact assessment	R	D		1
E-2	EIA conclusions require Environmental Impact Statement	NR			
E-3	Determination of health, environmental or related hazards. Assistance to determine existence of any health, environmental or related hazard may be requested from Aberdeen Proving Ground, MD 21010, the Office of the Surgeon General, Attn: DASG-HCH (Army Environmental Hygiene Agency)	NR			
E-4	Air/water pollution permit, coordination with agencies and compliance with standards at Federal, state and local level.	NR			
E-5	Corrective measures associated with Environmental Impact Statements or assessment—list separately and evaluate.	NR			
Other environmental considerations (list and number items)					
1. See Supplemental Data Detailed Project Justification Paragraph D9.					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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*** BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

10-9

APPENDIX D
TECHNICAL DATA CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM

- A-1 Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area average
- A-2 Construction phasing requirements
- A-3 Functional support equipment (mechanical, electrical, structural, and security) to be built in
- A-4 Equipment in place and justification
- A-5 Other equipment and furniture (D&MA, DPA) and costs
- A-6 Special studies and tests (hazards analysis, compatibility testing, new technology testing, etc.)
- A-7 Type of construction (permanent, temporary, semi-permanent)
- A-8 Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.
- Other special considerations (list and number items)

Required or Not Required	To Be Determined	Comment Attached	Document Attached
NR			
R	D		
NR			
NR			
NR			
NR			
NR			
NR			

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*** BY WHOM** (Check and insert appropriate letter)

A — DPAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

10-11

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Construction restrictions or guidelines pertaining to site access and preferred construction routes	R	A		
(A)		NR			
(B)	Airfield clearance, explosive storage, working hours, safety, etc.				
(C)	Facilities and/or functions or adjoining areas (structures, materials, impact)	NR			
B-2	Real estate actions (acquisition, disposal, lease, right-of-way)	NR			
B-3	Demolition/relocation required (data)				
(A)	Special considerations due to explosives/radioactivity/chemical contamination/asbestos emissions/toxic gases	R	A	1	
(B)	Restrictions on disposal of demolished/relocated material including hazardous waste	NR			
B-4	Pavement types and requirements (including traffic surveys and MTMC coordination)	NR			
B-5	Landscape considerations				
(A)	Protection of existing vegetation	NR			
(B)	Stockpile topsoil	NR			
Other Site Development (List and number items)					
1. There is a possibility that the existing lighting may contain PCB's in the ballasts.					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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***BY WHOM (Check and insert appropriate letter)**

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

10-12

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation	NR	D		
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)	NR			
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)	NR			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)	NR			
C-5	Designation and strength of units to be accommodated	NR			
C-6	Requirements and data for special design projects	NR			
C-7	Unusual floor and roof loads (safes, equipment)	NR			
C-8	Security features (arms rooms, vaults, interior secure areas)	NR			
Other Architectural & Structural (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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A — DFAE

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C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

10-13

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	NR			
D-2	Special peak usage periods and peak leveling techniques	NR			
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	D		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	NR			
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	NR			
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	NR			
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	R	D		
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	NR			
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	R	D		
D-10	Solar energy evaluation	NR			
Other Mechanical & Utility Systems (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

10-14

E. ENVIRONMENTAL CONSIDERATIONS

ITEM

Required or Not Required	To Be * Determined	Comment Attached	Document Attached
NR			

E-1 Waste water treatment, air quality, and solid waste disposal criteria

Other Environmental Considerations (List and number items)

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

10-15

F. FIRE PROTECTION

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
F-1	Special fire protection systems or features (detection and suppression equipment, hazards, etc.)	NR			
	Other Fire Protection Considerations (List and number items)				

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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*** BY WHOM** (Check and insert appropriate letter)

- A — DFAE
- B — Using Service
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- D — Designer
- E — Other (Check Comments Attached and explain)

technical data checklist

10-16

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA			2. DATE 1 November 93	
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois			4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		
5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER ECIP #2	8. PROJECT COST (\$000) \$1364		
9. COST ESTIMATES ¹					
ITEM		U/M	QUANTITY	UNIT COST	COST (\$000)
Primary Facility					
Interior Light Fixtures and Controls		Lot	1	1,240,000 ²	1,240
Subtotal					1,240
Design (5%)					62
Total Contract Cost					1,302
Supervision, Inspection and Overhead (5%)					62
Total Request					1,364
<p>10. DESCRIPTION OF PROPOSED CONSTRUCTION</p> <p>The existing interior lighting is a combination of standard efficiency fluorescent fixtures and mercury vapor. The proposed project will replace the interior lighting fixtures with T-8 fluorescent and high efficiency electronic ballasts and metal halide fixtures. The implementation of this project will save 17,100 MBtu/Yr of electrical energy (site). The first year savings is \$317,580 and the Savings to Investment Ratio (SIR) is 2.6.</p> <p>11. REQUIREMENT</p> <p>Project: The proposed interior lighting project replaces inefficient lighting in Building 350 with energy efficient lighting.</p> <p>Requirement: The project is required to reduce the energy consumption of lighting and to comply with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759. The proposed project will reduce annual energy consumption by 17,100 MBtu/Yr and annual energy cost by \$194,096.</p> <p>Current Situation: The existing lighting in Building 220 is inefficient fluorescent and mercury vapor.</p>					
<p>¹See Attached Detail Cost Estimate</p> <p>²Cost Has Been Escalated to Midpoint of Construction</p>					

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA		2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois			
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		5. PROJECT NUMBER ECIP #2	
<p>Impact if not provided: If the proposed project is not funded, a reduction of 17,100 MBtu/Yr cannot be achieved, and excessive amounts of energy will continue to be used. There will be no contribution to energy reduction goals established for United States Army facilities by Army Headquarters.</p>			
<p style="text-align: center;">_____ Colonel, USA Commanding</p>			
ESTIMATED CONSTRUCTION START:		September 1994	INDEX: 4.3%
ESTIMATED MIDPOINT OF CONSTRUCTION:		March 1995	INDEX: 2.25%
ESTIMATED CONSTRUCTION COMPLETION:		September 1995	INDEX: --
DETAILED JUSTIFICATIONS			
D1. GENERAL			
The proposed project encompasses the replacement of lighting in Building 350. The project will decrease the energy consumption of the lighting systems without reducing light levels.			
D2. ACCOMMODATIONS NOW IN USE:			
The existing lighting systems are comprised of standard efficiency fluorescent and incandescent fixtures.			
D3. ANALYSIS OF DEFICIENCY:			
Currently, the building is using standard or low efficiency fixtures for lighting. The purpose of this project is to replace the existing lighting with new light fixtures which are much more efficient. The current deficiency results in large amounts of energy usage to maintain adequate lighting.			

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA		2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois			
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		5. PROJECT NUMBER ECIP #2	
<p>D4. CONSIDERATION OF ALTERNATIVES:</p> <p>The only alternatives to proposed project are to install lower efficiency light fixtures. The disadvantages of using lower efficiency light fixtures is that less energy savings can be realized without significantly reducing the construction cost. If a less energy efficient fixture is selected, the project would have a lower SIR.</p> <p>D5. CRITERIA FOR PROPOSED PROJECT:</p> <p>The proposed project will conform will all applicable federal and United States Army Regulations.</p> <p>D6. PROGRAM FOR RELATED EQUIPMENT:</p> <p>No equipment funded from appropriations other than MCA are required.</p> <p>D7. DISPOSAL OF PRESENT ASSETS:</p> <p>Light fixtures in one building will be disposed.</p> <p>D8. SURVIVAL FACILITIES:</p> <p>The proposed project is not suitable for inclusion of protective shelters.</p> <p>D9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES:</p> <p>The proposed project has been analyzed and will not adversely impact the environment. Energy savings resulting from the project will conserve natural resources.</p> <p>D10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS:</p> <p>It has been determined that these facilities are not located in a flood plain and they do not encroach on wetlands.</p> <p>D11. ECONOMIC JUSTIFICATION:</p> <p>The proposed project qualifies under ECIP Guidelines in AR-415-15. SIR for the project is 2.6 with a simple payback of 4.3 years.</p> <p>See Economic Analysis, SRP-1</p>			

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		5. PROJECT NUMBER ECIP #2
<p>D12. UTILITY AND COMMUNICATION SUPPORT:</p> <p>A. No related utility support projects are programmed. Adequate utilities are available to support the project.</p> <p>B. No telecommunication support is required.</p> <p>D13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES:</p> <p>The project involves the replacement of light fixtures and installation of lighting controls in an existing building. Review procedures have been implemented for this project in accordance with 36 CFT 800.</p> <p>D14. PROJECT DEVELOPMENT BROCHURE (PART 1):</p> <p>A Project Development Brochure was prepared on 1 November 93 and is attached as a part of the programming documentation.</p> <p>D15. ENERGY REQUIREMENTS:</p> <p>The proposed project will reduce present energy consumption by 17,100 MBtu/Yr at a cost savings of \$317,580. See Energy Requirements Appraisal (ERA) in Special Requirements, Paragraph 3 (SRP-3).</p> <p>D16. PROVISION FOR THE HANDICAPPED:</p> <p>No provisions for the handicapped will be made since the scope of the project is in no way applicable to designing for the handicapped.</p> <p>D17. REAL PROPERTY MAINTENANCE ACTIVITY (RPMA) ANALYSIS:</p> <p>A. Physical impact: No new structures will be added.</p>		

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93										
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois												
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		5. PROJECT NUMBER ECIP #2										
<p>B. Operations and Maintenance (O&M) impact:</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;"><u>YEAR</u></th> <th style="text-align: center;"><u>O&M</u> <u>NET CHANGE (\$000)</u></th> </tr> </thead> <tbody> <tr> <td>1994</td> <td style="text-align: center;">0.0</td> </tr> <tr> <td>(BOD)</td> <td style="text-align: center;">0.0</td> </tr> <tr> <td>1995</td> <td style="text-align: center;">0.0</td> </tr> <tr> <td>1996</td> <td style="text-align: center;">0.0</td> </tr> </tbody> </table> <p>C. Backlog of Maintenance and Repair (BMAR) impact:</p> <p>There will be net increase in the number of fixtures or in fixture life expectancy. There will be no effect on BMAR.</p> <p>D18. COMMERCIAL ACTIVITIES:</p> <p>The proposed project is not a "New Start Expansion" as defined by DA Circular 235-1. The project has been reviewed in light of the requirements of commercial and industrial facilities. It has been determined that whereas the project does not affect commercial facilities, the requirements of DA Circular 235-1 does not apply.</p>			<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>	1994	0.0	(BOD)	0.0	1995	0.0	1996	0.0
<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>											
1994	0.0											
(BOD)	0.0											
1995	0.0											
1996	0.0											

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		5. PROJECT NUMBER ECIP #2

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$ 1,162,000 ³
B. SIOH	\$ 59,000
C. DESIGN COST	\$ 59,000
D. TOTAL COST (1A + 1B + 1C)	\$ 1,280,000
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$ 0
F. PUBLIC UTILITY COMPANY REBATE	\$ 0
G. TOTAL INVESTMENT (1D-1E-1F)	\$ 1,280,000

2. ENERGY SAVINGSS(+)/COST(-):

DATE OF NISTIR 85-3273X USED FOR DISCOUNT FACTORS **OCTOBER 1992**

ENERGY SOURCE	COST \$/MBTU (1)	SAVINGS MBTU/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	\$ 9.90	\$ 17,100	\$ 169,290	11.19	\$ 825,000
B. DIST	\$	\$	\$	\$	\$
C. RESID	\$	\$	\$	\$	\$
D. NG	\$	\$	\$	\$	\$
E. PPG	\$	\$	\$	\$	\$
F. COAL	\$	\$	\$	\$	\$
G. SOLAR	\$	\$	\$	\$	\$
H. GEOTH	\$	\$	\$	\$	\$
I. BIOMA	\$	\$	\$	\$	\$
J. REFUS	\$	\$	\$	\$	\$
K. WIND	\$	\$	\$	\$	\$
L. OTHER	\$	\$	\$	\$	\$
M. DEMAND SAVINGS	\$	\$	\$ 24,805	\$	\$ 278,000
N. TOTAL	\$	\$ 17,100	\$ 194,096	\$	\$ 2,172,000

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$ 123,500

(1) DISCOUNT FACTOR (TABLE A-2) 11.12

(2) DISCOUNTED SAVINGS/COST (3A x 3A1) \$ 1,373,000

B. NON-RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR (3)	DISCOUNTED SAVINGS/COST (+/-) (4)
a. 0	\$ 0	0	0	\$ 0
b.	\$	\$	\$	\$
c.	\$	\$	\$	\$
d. TOTAL	\$	\$	\$	\$

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2 + 3Bd4) \$ 1,373,000

4. SIMPLE PAYBACK 1G/(2N3 + 3A + 3Bd1/Economic Life): 4.0 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5 + 3C): \$ 3,545,000

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 2.8

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 11.4%

Economic Life 15 Yrs

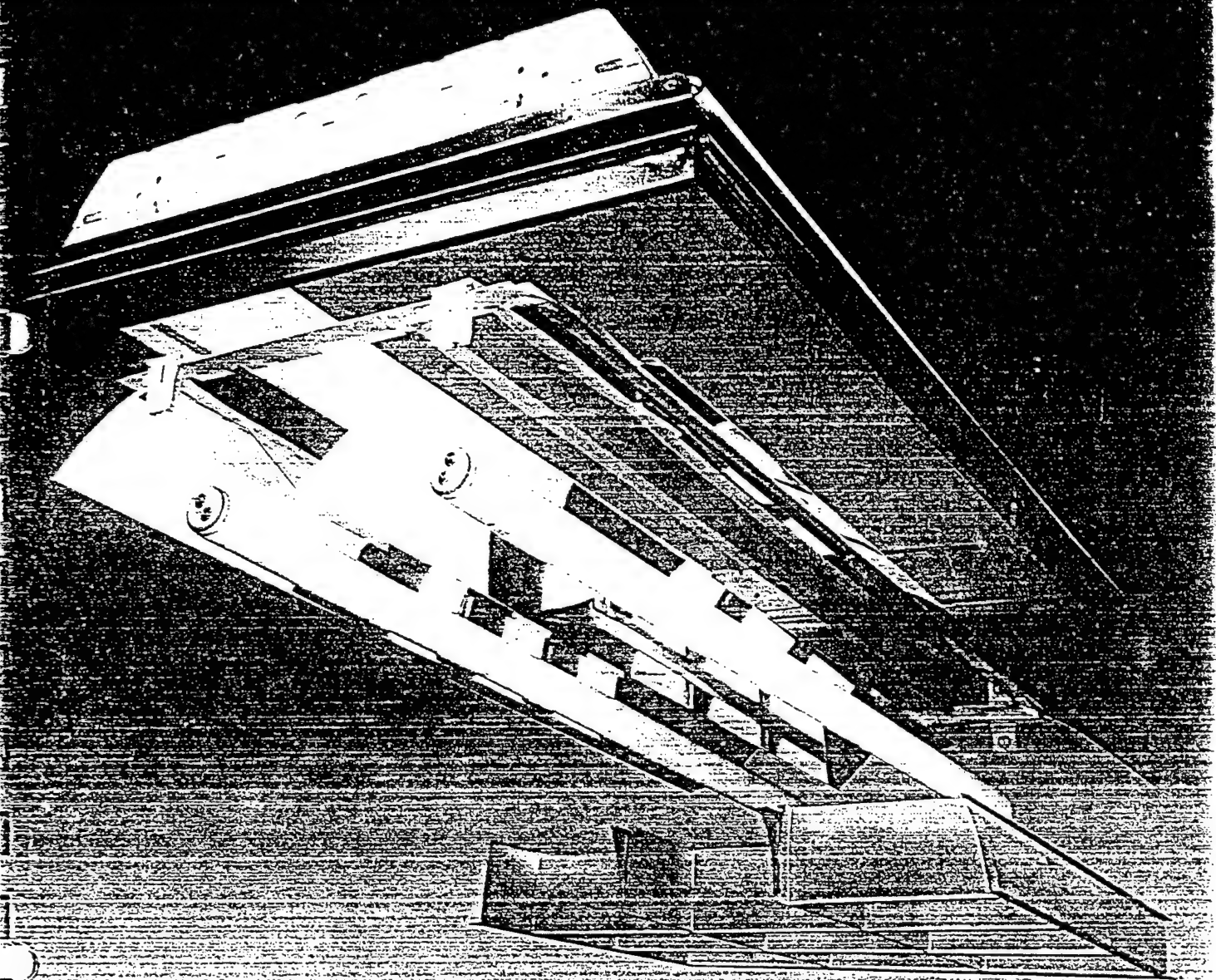
³ Costs are Unescalated

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE LIGHTING REPLACEMENT IN BUILDING 350		5. PROJECT NUMBER ECIP #2
<p>SPECIAL REQUIREMENTS PARAGRAPH 3 (SRP-3):</p> <p>Energy Requirements Appraisal (ERA)</p> <p>1. Project Description: Replace existing lighting systems with more efficient lighting systems without reducing the light levels.</p> <p>2. Estimated Energy Consumption: The buildings are currently lit by standard efficiency lighting. Replacing the existing lighting with high efficiency lighting will result in 17,100 MBtu/Yr of electrical energy savings, a seventy-five percent (75%) reduction in current energy consumption.</p> <p>3. Energy Sources: No new energy sources are required for the proposed project. The use of solar energy for this project is impractical.</p> <p>4. Energy Use Impacts: The proposed project will substantially reduce the consumption of electricity for lighting. The burden on the existing base distribution system will be lessened.</p> <p>5. Energy Conservation: The proposed project will reduce annual energy consumption by 17,100 MBtu/Yr with annual energy cost savings of \$194,096. The project complies with Army Resources Management Plan (ERMP) and Executive Order 12759.</p> <p>6. Energy Alternatives: The proposed project represents the greatest possible reduction in energy consumption without reducing the current lighting levels.</p> <p>7. Energy Effects: The proposed project provides positive environmental effects. It reduces the current energy consumption effectively, reducing the consumption of non-renewable fuel sources. The degrading of environmental standards would not make more efficient energy sources available.</p> <p>8. Basis of Approval: Total energy requirements and alternative fuel sources have been considered and included in this appraisal or discarded as applicable.</p>		

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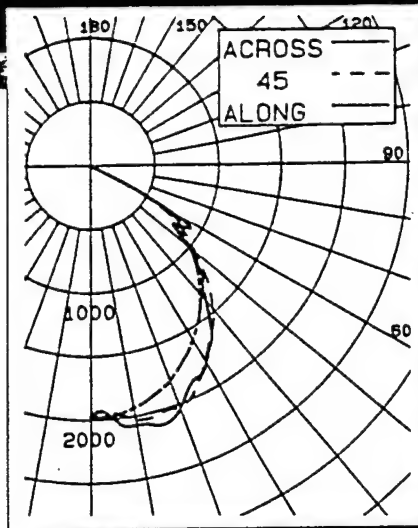


Parke Powerlite 4 Series



Parke Powerlite 3 Series

(2x4/2 Lamp/StaticTrougher)



The Parke Powerlite is a low profile recessed fixture made of one-piece code gauge steel, die-formed and embossed. This fixture's high light output and high efficiency features a three-piece silver reflector with 94% plus specular reflectivity. The reflector is made of a rigid base metal substrate with silver film attached by a heat activated cross-link adhesive. The silver is protected by an ultra-violet inhibited polyester film and is guaranteed for ten years not to crack, peel or delaminate. The PP3 Series is our most versatile series featuring a variety of lens/louver options, easy access plate that permits wiring without opening the fixture and an excellent space to mounting height. This fixture is available in surface mount or recessed applications.

Model #PP324ESPS75A1

CANDLEPOWER SUMMARY

ANGLE	ALONG 22.5	45	67.5	ACROSS	OUTPUT LUMEN
0	1966	1966	1966	1966	1966
5	1970	1942	1944	1970	1988
10	1932	1924	2025	2069	2070
15	1871	1928	2028	2090	2112
20	1799	1891	2021	2027	2035
25	1694	1842	1930	1899	1870
30	1581	1754	1781	1783	1795
35	1462	1662	1629	1631	1641
40	1317	1520	1474	1431	1386
45	1169	1358	1284	1198	1224
50	1003	1175	1059	1005	1002
55	822	944	883	812	786
60	671	669	605	668	777
65	93	149	118	143	91
70	5	6	5	7	8
75	3	6	1	6	4
80	8	4	5	2	7
85	8	4	5	2	6
90	0	0	0	0	0

#9856 - PARKE POWERLITE 3 SERIES...RECESSED 2x4 LUMINAIRE
MODEL # PP324ESPS75A1, SILVER REFLECTOR, (2) F40T12/WW
LAMPS, (1) ADVANCE R-2S40-1-TP BALLAST, 3/4 x 3/4 SPECULAR
LOUVER. LUMEN RATING = 3200.

- Code gauge steel
- 4" deep troffer
- 3/4" x 3/4" silver paracube louver
- Energy saver ballast
- (2) F40T12 lamps
- 3-piece specular silver reflector w/tablock fastening
- 2' x 4'
- Designed specifically for computer applications

COEFFICIENTS OF UTILIZATION ZONAL CAVITY METHOD EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

		EFFECTIVE FLOOR AREA (SQUARE FEET)																				
CC WALL		80				70				50				30				10				0
		70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10				
RCR	0	.86	.86	.86	.86	.84	.84	.84	.84	.80	.80	.80	.77	.77	.77	.73	.73	.73	.72			
	1	.81	.78	.76	.74	.79	.77	.74	.73	.73	.72	.70	.71	.69	.68	.68	.67	.66	.65			
	2	.75	.71	.67	.64	.74	.69	.66	.63	.67	.64	.62	.65	.63	.61	.63	.61	.59	.58			
	3	.70	.64	.59	.56	.68	.63	.59	.55	.61	.57	.54	.59	.56	.54	.57	.55	.53	.51			
	4	.65	.58	.53	.49	.63	.57	.52	.48	.55	.51	.48	.54	.50	.47	.52	.49	.47	.45			
	5	.60	.52	.46	.42	.58	.51	.46	.42	.50	.45	.42	.48	.44	.41	.47	.44	.41	.40			
	6	.55	.47	.41	.37	.54	.46	.41	.37	.45	.40	.37	.44	.40	.36	.43	.39	.36	.35			
	7	.51	.42	.37	.33	.50	.42	.36	.32	.41	.36	.32	.39	.35	.32	.39	.35	.32	.30			
	8	.47	.38	.32	.28	.46	.37	.32	.28	.36	.32	.28	.36	.31	.28	.35	.31	.28	.26			
	9	.43	.34	.28	.25	.42	.34	.28	.25	.33	.28	.24	.32	.27	.24	.31	.27	.24	.23			
	10	.40	.31	.25	.22	.39	.30	.25	.22	.30	.25	.22	.29	.25	.21	.29	.24	.21	.20			

83.1 Watts

ZONAL LUMENS AND PERCENTAGES

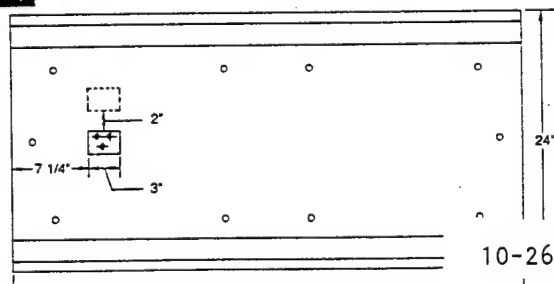
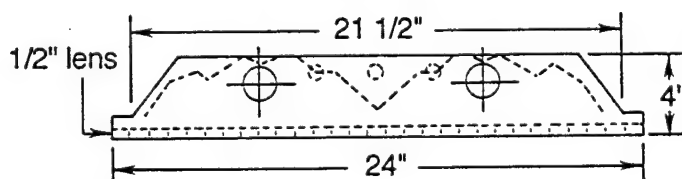
ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	1615	25.24	35.05
0-40	2625	41.03	56.97
0-60	4371	68.30	94.84
0-90	4609	72.02	100.00
40-90	1983	30.99	43.03
60-90	237	3.71	5.16
90-180	0	.00	.00
0-180	4609	72.02	100.00

** EFFICIENCY = 72.0% **

S/MH = 1.3

SC(ALONG) = 1.2

SC(ACROSS) = 1.3



Model #PP4242ESDC12B1

#7568 - PARKE POWERLITE 4 SERIES
RECESSED 2X4 LUMINAIRE, MODEL
PP4242ESDC12B1, SILVER REFLECTOR, (2)
F40T12/WW LAMPS, (1) ADVANCE R - 2540
BALLAST, 12 - CELL SEMI - SPECULAR 3"
DEEP LOUVER, LUMEN RATING = 3200.

- Code gauge steel
- 6" deep troffer
- 3" 12 - cell semi - specular parabolic bower
- Energy saver ballast
- (2) F40T12 lamps
- 3 - piece specular silver reflector with tablock fastening
- 2'X4'

Model #PP4242OEDC12B1

#9655 - PARKE POWERLITE 4 SERIES, RECESSED
2X4 LUMINAIRE, MODEL #PP4242OEDC12B1,
SILVER REFLECTOR, (2) GE F032S94 12"
WATT T8 LAMPS, (1) TRIAD B33120 ELEC-
TRONIC BALLAST, 12 - CELL SEMI - SPECULAR
3" DEEP LOUVER, LUMEN RATING = 2950.

- Code gauge steel
- 3" 12 - cell semi - specular parabolic bower
- Electronic ballast
- (2) T8 lamps
- 3 - piece specular silver reflector with tablock fastening
- 2'X4'

Model #PP4222BXDC09B1

#1918A - PARKE POWERLITE 4 SERIES, 2X2
LUMINAIRE, MODEL #PP4222BXDC09B1,
SILVER REFLECTOR, (2) GE F040BXSP35RS,
1 BALLAST, 9 - CELL SEMI - SPECULAR 3"
DEEP LOUVER, LUMEN RATING = 3150.

- Code gauge steel
- 3" 9 - cell semi - specular bower
- Black magnetic ballast
- (2) F40 BX lamps
- 3 - piece specular silver reflector with tablock fastening
- 2'X2'

PARKE INDUSTRIES INC.

ZONE LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP LUMINAIRE
0.30	1671	26.12
0.40	2788	43.57
0.60	4406	68.85
0.90	4972	74.89
1.00	5004	75.32
40.90	366	6.00
90.100	0	0.00
0.100	4972	74.89
1.000	5004	75.32
EFFICIENCY = 44.1%		
SCALE = 1.1		
SCALE/COEFF = 1.3		

ZONE LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP LUMINAIRE
0.30	1753	29.72
0.40	2640	46.15
0.60	4637	78.93
0.90	4637	81.99
1.00	4637	81.99
40.90	180	3.06
90.100	0	0.00
0.100	4637	81.99
1.000	4637	81.99
EFFICIENCY = 42.0%		
SCALE = 1.1		
SCALE/COEFF = 1.3		

ZONE LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP LUMINAIRE
0.30	1635	26.0
0.40	2695	41.2
0.60	3968	62.7
0.90	4061	64.5
1.00	4061	64.5
40.100	0	0.00
0.100	4061	64.5
1.000	4061	64.5
EFFICIENCY = 44.1%		
SCALE = 1.1		
SCALE/COEFF = 1.3		

Coefficients of Utilization Zonal Cavity Method

CC	WALL	0	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0

83.1 Watts

Coefficients of Utilization Zonal Cavity Method

CC	WALL	0	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0

63.1 Watts

Coefficients of Utilization Zonal Cavity Method

CC	WALL	0	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0

83.1 Watts

Candlepower Summary

ANGLE ALONG	22.5	45	67.5	ACROSS	OUTPUT LUMENS
0	2011	2011	2011	2011	193
5	2000	2000	2000	2000	193
10	2000	2000	2000	2000	193
15	2000	2000	2000	2000	193
20	2000	2000	2000	2000	193
25	2000	2000	2000	2000	193
30	2000	2000	2000	2000	193
35	2000	2000	2000	2000	193
40	2000	2000	2000	2000	193
45	2000	2000	2000	2000	193
50	2000	2000	2000	2000	193
55	2000	2000	2000	2000	193
60	2000	2000	2000	2000	193
65	2000	2000	2000	2000	193
70	2000	2000	2000	2000	193
75	2000	2000	2000	2000	193
80	2000	2000	2000	2000	193
85	2000	2000	2000	2000	193
90	2000	2000	2000	2000	193

Candlepower Summary

ANGLE ALONG	22.5	45	67.5	ACROSS	OUTPUT LUMENS
0	2011	2011	2011	2011	193
5	2000	2000	2000	2000	193
10	2000	2000	2000	2000	193
15	2000	2000	2000	2000	193
20	2000	2000	2000	2000	193
25	2000	2000	2000	2000	193
30	2000	2000	2000	2000	193
35	2000	2000	2000	2000	193
40	2000	2000	2000	2000	193
45	2000	2000	2000	2000	193
50	2000	2000	2000	2000	193
55	2000	2000	2000	2000	193
60	2000	2000	2000	2000	193
65	2000	2000	2000	2000	193
70	2000	2000	2000	2000	193
75	2000	2000	2000	2000	193
80	2000	2000	2000	2000	193
85	2000	2000	2000	2000	193
90	2000	2000	2000	2000	193

Candlepower Summary

ANGLE ALONG	22.5	45	67.5	ACROSS	OUTPUT LUMENS
0	2011	2011	2011	2011	193
5	2000	2000	2000	2000	193
10	2000	2000	2000	2000	193
15	2000	2000	2000	2000	193
20	2000	2000	2000	2000	193
25	2000	2000	2000	2000	193
30	2000	2000	2000	2000	193
35	2000	2000	2000	2000	193
40	2000	2000	2000	2000	193
45	2000	2000	2000	2000	193
50	2000	2000	2000	2000	193
55	2000	2000	2000	2000	193
60	2000	2000	2000	2000	193
65	2000	2000	2000	2000	193
70	2000	2000	2000	2000	193
75	2000	2000	2000	2000	193
80	2000	2000	2000	2000	193
85	2000	2000	2000	2000	193
90	2000	2000	2000	2000	193

FOOTCANDLE AND ENERGY SELECTOR

SQ. FT. PER. FIX.	1	2	3	4	RCR	5	6	7	8	9	10	WATTS PER SQ. FT.
16	255	232	209	190	171	155	142	129	116	106	5.30	
24	170	155	139	127	114	103	94	86	77	71	3.53	
25	163	148	134	121	109	99	90	82	74	68	3.39	
32	127	116	104	95	85	77	71	64	58	53	2.65	
36	113	103	93	84	76	68	63	57	51	47	2.35	
40	102	93	83	76	68	62	56	51	46	42	2.12	
48	85	77	69	63	57	51	47	43	38	35	1.76	
50	81	74	67	60	54	49	45	41	37	34	1.69	
60	68	62	55	50	45	41	37	34	31	28	1.41	
64	63	58	52	47	42	38	35	32	29	26	1.32	
72	56	51	46	42	38	34	31	28	25	23	1.17	
80	51	46	41	38	34	31	28	25	23	21	1.06	
96	42	38	34	31	28	25	23	21	19	17	0.88	
100	40	37	33	30	27	24	22	20	18	17	0.84	
120	34	31	27	25	22	20	18	17	15	14	0.70	

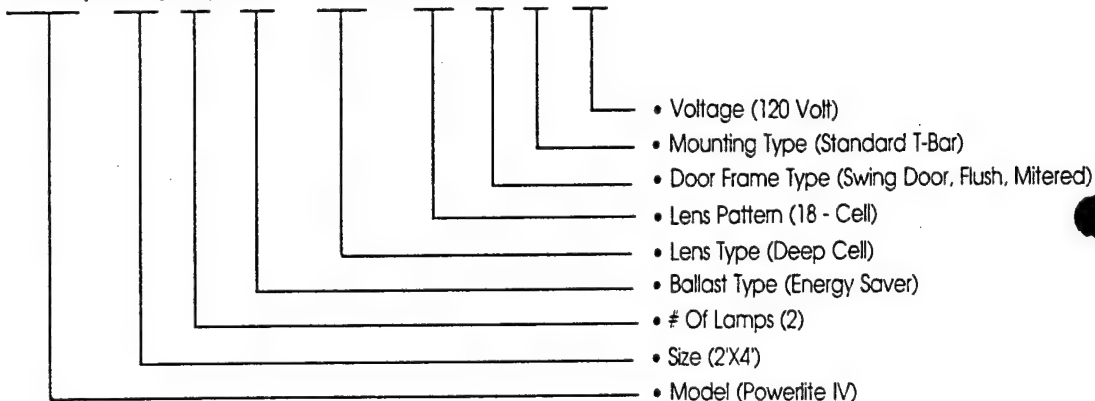
CRITERIA:

1. ILLUMINATION, TOTAL AREA COVERAGE
2. BASED ON PHOTOMETRIC REPORT, LS19864
3. REFLECTANCE, 80-50-20
4. NUMBER OF LAMPS, 2
5. LUMENS PER LAMP, 3200
6. WATTS PER FIXTURE, 84.9
7. MAINTENANCE FACTOR(LLF), .85
8. BALLAST FACTOR, .95.

Ordering Guidelines

Example: PP4/24/2/ES/DC/18/B/1/1

When ordering the Parke Powerlite, the guidelines show the luminaire's type and specifications, therefore, all fifteen (15) characters of the fixture code must appear on the Purchase Order (P.O.) to ensure proper ordering.



**PARKE
INDUSTRIES
INC.**

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2246 Lindsay Way
Glendora, CA 91740
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FAX: (714) 599-1208

Rocky Mountain Division
213 South Second Avenue
Louisville Superior, CO 80027
Tel: (303) 494-2659
FAX: (303) 494-2659

Midwest Division
5030 West Lawrence Avenue
Chicago, IL 60630
Tel: (312) 794-0404
FAX: (312) 286-0411

Northwest Division
1139 Grandview Drive
South San Francisco, CA 94080
Tel: (415) 742-6390
FAX: (415) 742-6432

Southeast Division
2819 Devine Street, Suite 201
Columbia, SC 29205
Tel: (803) 776-4529
FAX: (803) 695-0510

Parke Industries of Canada
6113 Ross Road
Sardis, British Columbia
Canada V2R 1B1
Tel: (604) 858-0666
FAX: (604) 858-0410

UL Underwriters Laboratories Inc.

FLUORESCENT FIXTURE ISSUE #C-44,690
RECESSED FLUORESCENT FIXTURE ISSUE #A-521-180
RECESSED FLUORESCENT FIXTURE ISSUE #A-521, 172
FIXTURE CONVERSION REFLECTOR KIT CLASSIFIED BY UNDERWRITERS LABORATORIES, INC. E11269

Due to our continuing efforts to manufacture the best product, design and specifications are subject to change without notice. Please consult the factory for fixture options.



MOTOROLA
Lighting Inc.

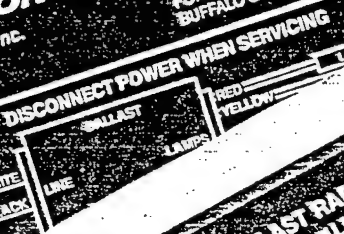


3 LAMPS
INPUT:
120 VOLTS AC 60 Hz



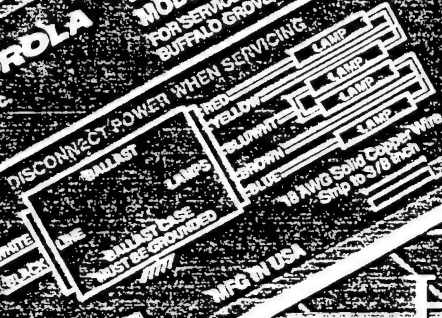
MOTOROLA
Lighting Inc.

ELECTRONIC BALLAST RAPID START
MODEL NO. MS-RN-T12-1LL-120
FOR SERVICE 1-800-MU-3089
BUFFALO GROVE, IL 60089
NO PCB'S



MOTOROLA
Lighting Inc.

ELECTRONIC BALLAST RAPID START
MODEL NO. MA-RN-T8-1LL-277
FOR SERVICE 1-800-MU-3089
BUFFALO GROVE, IL 60089
NO PCB'S



CLASS P HIGH POWER FACTOR
LAMP TYPE T8270 T8275
32W 35W
44 AMP 35 AMP
SOUND RATING-A
MIN. STARTING TEMP 50° F
50° F

INSTALL IN ACCORDANCE WITH
NATIONAL AND LOCAL ELECTRICAL CODES

**HIGH PERFORMANCE
ELECTRONIC BALLASTS**
FLUORESCENT 1, 2, 3 and 4 LAMP
RAPID START

Total Customer Satisfaction



MOTOROLA

Lighting Inc.

Total Customer Satisfaction

CUSTOMER SUPPORT 1-800-MLI-0089

HIGH PERFORMANCE FEATURES

Power Factor:	Greater than .99
Total Harmonic Distortion:	Less than 10%
Third Harmonic Distortion:	Less than 6%
Lamp Current Crest Factor:	Less than 1.5
Lamp Current Frequency:	Greater than 25 KHz
Lamp Configuration:	Series
Lamp Flicker:	Less than 2%, Not Visible
Sound Rating:	Class A
Projected Life:	20 years plus
Connector:	Poke-in wire trap for 18 gauge (solid wire)
Weight:	1.2 lbs.
EMI:	Meets FCC Part 18, Subpart C

CODES

UL Listed:	Class P
Transient Protection:	Meets ANSI C62.41, Cat. A (Formerly IEEE 587)

WIRETRAP CONNECTOR

OUR UNIQUE POKE-IN
CONNECTORS SIMPLIFY INSTALLATION
AND SAVE TIME.



PART NUMBER DESCRIPTION

MODEL NUMBER EXPLANATION					
MS	4	R	N	T8	1LL-277
Motorola Lighting Inc. Electronic Ballast	4 Pin Rapid Start	R = Rapid Start	N = Normal	T8 = T8 Lamp	1LL-277 = 1 Lamp, 277V
120					

QUALITY

Motorola's goal of acceptable quality is at Six Sigma or no more than 3.4 defects per million opportunities. Motorola Lighting Inc. designed its electronic ballast to meet the most rigorous performance standards at world class levels. This translates into a highly robust product that goes through extensive environmental stress testing to assure our customers of very low initial defect levels (less than 0.1%) and high reliability (greater than 500,000 hours Mean Time to Failure—MTTF).

The economic ballast life is 20 years when operated at 45°C ambient temperature. Operation of MLI's ballast at 50°C may derate life expectancy by 25%.

Six Sigma Quality means "world class" in all that we do at Motorola Lighting Inc., which is part of our commitment to TOTAL CUSTOMER SATISFACTION.



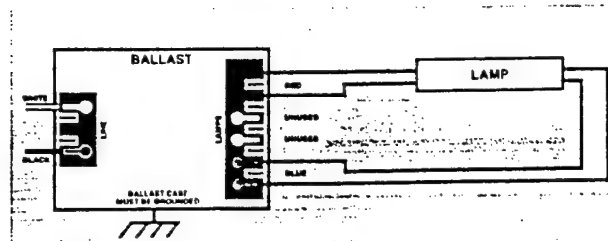
RAPID START BALLASTS

Lamp Type	Rated Lamp Wattage (W)	Lamp Length (FT)	Model No.	Line Voltage (V)	Max Line Current (A)	Typical Line Current (A)	Typical Input Power (W)		Min. Starting Temp (F)
							Open	Enclosed	
1 LAMP T8									
F32T8	32	4	M1-RN-T8-1LL-120	120	.31	.24	29	28	50°
F32T8	32	4	M1-RN-T8-1LL-277	277	.13	.11	29	28	50°
F25T8	25	3	M1-RN-T8-1LL-120	120	.24	.19	23	22	50°
F25T8	25	3	M1-RN-T8-1LL-277	277	.10	.08	23	22	50°
F17T8	17	2	M1-RN-T8-1LL-120	120	.17	.13	16	15	50°
F17T8	17	2	M1-RN-T8-1LL-277	277	.07	.08	16	15	50°
2 LAMP T8									
F32T8	32	4	M2-RN-T8-1LL-120	120	.55	.51	61	58	50°
F32T8	32	4	M2-RN-T8-1LL-277	277	.24	.21	59	56	50°
F25T8	25	3	M2-RN-T8-1LL-120	120	.42	.40	48	45	50°
F25T8	25	3	M2-RN-T8-1LL-277	277	.18	.17	46	44	50°
F17T8	17	2	M2-RN-T8-1LL-120	120	.27	.24	32	29	50°
F17T8	17	2	M2-RN-T8-1LL-277	277	.12	.10	34	31	50°
2 LAMP T12									
F40T12	40	4	M2-RN-T12-1LL-120	120	.64	.59	71	69	50°
F40T12	40	4	M2-RN-T12-1LL-277	277	.27	.25	69	67	50°
F40T12	34	4	M2-RN-T12-1LL-120	120	.54	.50	60	59	60°
F40T12	34	4	M2-RN-T12-1LL-277	277	.23	.21	58	57	60°
F40T10	40	4	M2-RN-T12-1LL-120	120	.64	.60	72	71	50°
F40T10	40	4	M2-RN-T12-1LL-277	277	.27	.25	70	69	50°
F30T12	30	3	M2-RN-T12-1LL-120	120	.48	.44	53	52	50°
F30T12	30	3	M2-RN-T12-1LL-277	277	.21	.19	52	50	50°
F30T12	25	3	M2-RN-T12-1LL-120	120	.40	.37	44	43	60°
F30T12	25	3	M2-RN-T12-1LL-277	277	.17	.16	43	42	60°
3 LAMP T8									
F32T8	32	4	M3-RN-T8-1LL-120	120	.78	.76	90	87	50°
F32T8	32	4	M3-RN-T8-1LL-277	277	.33	.32	89	85	50°
F25T8	25	3	M3-RN-T8-1LL-120	120	.61	.59	70	67	50°
F25T8	25	3	M3-RN-T8-1LL-277	277	.26	.25	69	66	50°
F17T8	17	2	M3-RN-T8-1LL-120	120	.39	.35	47	44	50°
F17T8	17	2	M3-RN-T8-1LL-277	277	.16	.14	44	41	50°
3 LAMP T12									
F40T12	40	4	M3-RN-T12-1LL-120	120	.92	.90	107	105	50°
F40T12	40	4	M3-RN-T12-1LL-277	277	.45	.38	105	103	50°
F40T12	34	4	M3-RN-T12-1LL-120	120	.84	.77	91	89	60°
F40T12	34	4	M3-RN-T12-1LL-277	277	.41	.33	90	88	60°
F40T10	40	4	M3-RN-T12-1LL-120	120	.99	.92	109	107	50°
F40T10	40	4	M3-RN-T12-1LL-277	277	.48	.39	107	105	50°
F30T12	30	3	M3-RN-T12-1LL-120	120	.76	.67	80	78	50°
F30T12	30	3	M3-RN-T12-1LL-277	277	.37	.29	78	76	50°
F30T12	25	3	M3-RN-T12-1LL-120	120	.71	.57	67	65	60°
F30T12	25	3	M3-RN-T12-1LL-277	277	.35	.24	66	64	60°
4 LAMP T8									
F32T8	32	4	M4-RN-T8-1LL-120	120	1.04	1.02	121	118	50°
F32T8	32	4	M4-RN-T8-1LL-277	277	.44	.43	118	115	50°
F25T8	25	3	M4-RN-T8-1LL-120	120	.81	.80	95	91	50°
F25T8	25	3	M4-RN-T8-1LL-277	277	.35	.34	93	90	50°
F17T8	17	2	M4-RN-T8-1LL-120	120	.55	.49	67	64	50°
F17T8	17	2	M4-RN-T8-1LL-277	277	.22	.19	61	58	50°

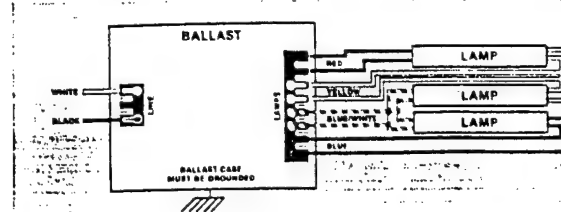
Ballast Will Operate the U-Shaped Equivalents of the Above Lamps. Test Data from Independent Test Lab Available on Request from Factory.

WIRING DIAGRAMS AND BALLAST DIMENSIONS

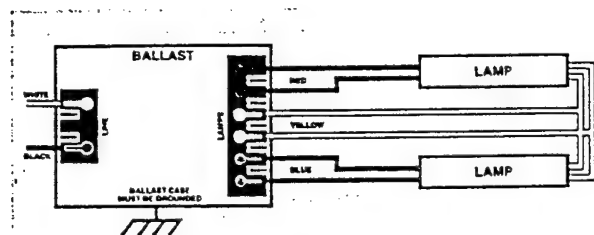
WIRING DIAGRAMS



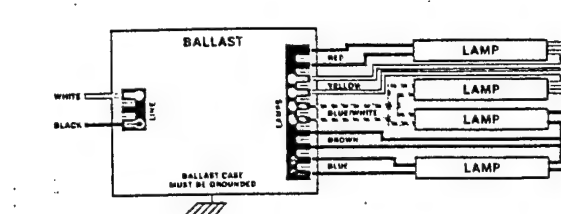
1 LAMP



3 LAMP

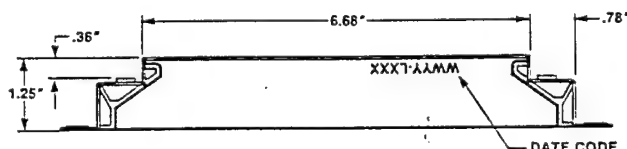
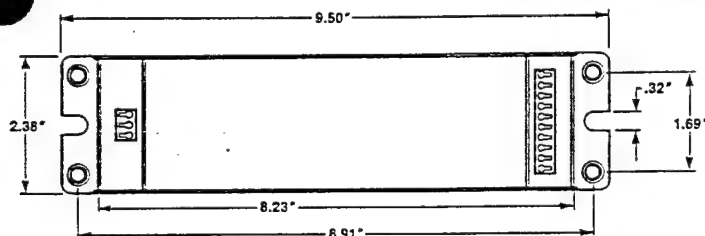


2 LAMP

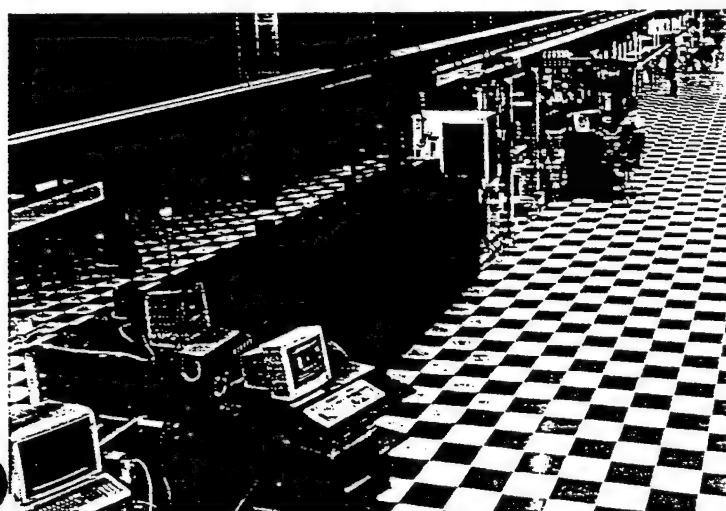


4 LAMP

BALLAST DIMENSIONS*



*BALLAST IS SYMMETRICAL FOR MOUNTING PURPOSES



Our state-of-the-art manufacturing facility in Buffalo Grove, Illinois—in the U.S.A.



MOTOROLA
Lighting Inc.

887 Deerfield Parkway
Buffalo Grove, IL 60089
1-800-MLI-0089

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ENERGY EFFICIENCY IN LIGHTING

**LIGHTWAY
INDUSTRIES**

CEILINGWAY Low Profile

A classic ceiling fixture with clean, angular lines designed to blend in with a wide variety of architectural styles. The high light output and close profile make it an excellent choice for bathrooms, kitchens and corridors.

OPTIONS AVAILABLE

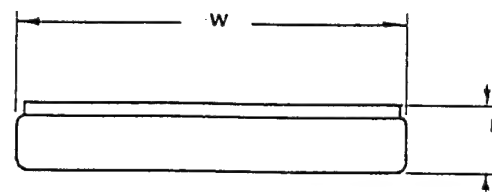
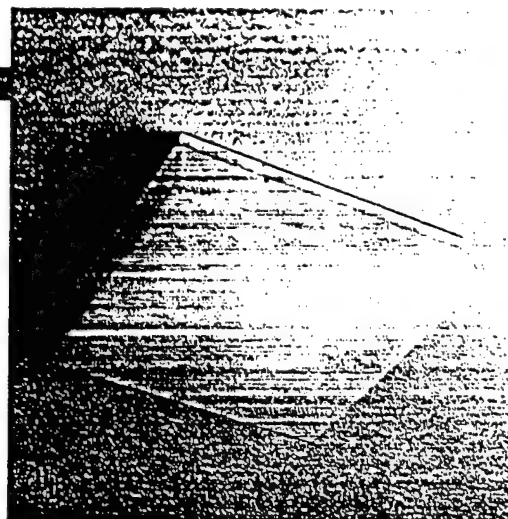
- Cold weather or 277v ballast
- Rapid start ballast for 22 watt
- White polycarbonate diffuser
- Black trim
- Custom color finish
- Emergency Ballast - extended pan req'd
- Tamper proof screws (tool available)



STANDARD FEATURES

- **Construction** Heavy gauge steel
- **Pan** White polyester powder coated
- **Diffuser** White, non-yellowing acrylic
- **Ballast** Rapid start on 32 & 54 watt
- **UL Listed** Damp location
- Mounting hardware & lamp(s)

MODEL	LAMP	W	D	L
CS13LP	13 watt	14"	3 1/4"	14"
CS26LP	2-13 watt	14"	3 1/4"	14"
CS20LP	20 watt	14"	3 1/4"	14"
CS22LP	22 watt	14"	3 1/4"	14"
CS32LP	32 watt	14"	3 1/4"	14"
CS54LP	22 & 32 watt	14"	3 1/4"	14"



CEILINGWAY Square

An economical square ceiling fixture, designed for both strength and economy. Available with circline or twin tube lamps. Optional clear or white polycarbonate diffuser and tamper proof screws are available.

OPTIONS AVAILABLE

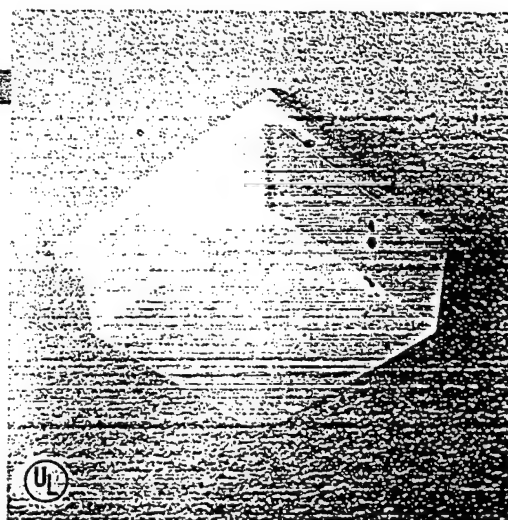
- Cold weather or 277v ballast
- Rapid start ballast for 22 watt
- Clear prismatic acrylic diffuser
- Clear prismatic or white polycarbonate diffuser
- Tamper proof screws (tool available)
- Emergency Ballast - extended pan req'd
- High Pressure Sodium - see new CEILINGWAY HPS/MH on page 19



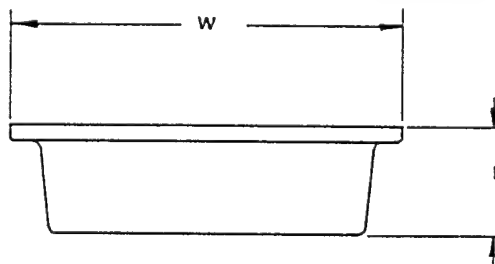
STANDARD FEATURES

- **Construction** Heavy gauge steel
- **Pan** White polyester powder coated
- **Diffuser** White, non-yellowing acrylic
- **UL Listed** Damp location
- Mounting hardware & lamp(s)

MODEL	LAMP	W	D	L
CS9	9 watt	10 1/2"	4"	10 1/2"
CS13	13 watt	10 1/2"	4"	10 1/2"
CS18	2-9 watt	10 1/2"	4"	10 1/2"
CS26	2-13 watt	10 1/2"	4"	10 1/2"
CS20	20 watt	10 1/2"	4"	10 1/2"
CS22	22 watt	10 1/2"	4"	10 1/2"



Note: To convert existing fixture to fluorescent see CWS retrofit, page 27



SIDEWAY

A sister to our SLIMWAY with the same low profile construction, UL Wet Listing and white polycarbonate lens. SIDEWAY is designed for compact fluorescent lighting to 26 watts (2-13 watt). Optional photo cell shown is available.

OPTIONS AVAILABLE

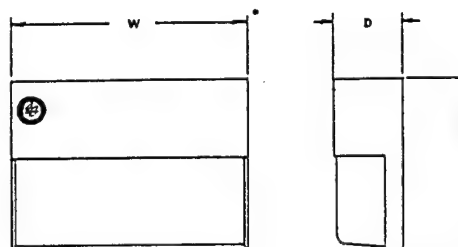
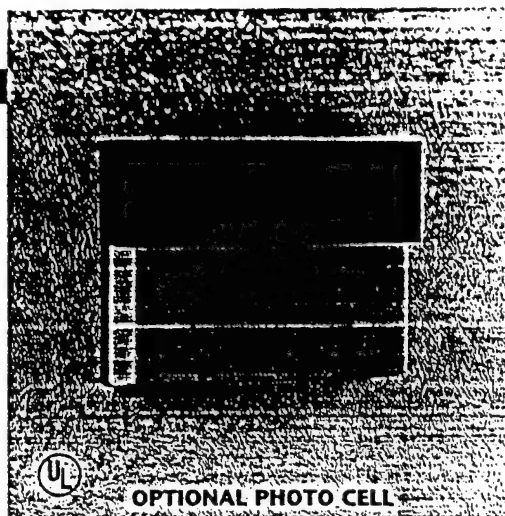
- Clear polycarbonate diffuser
- Cold weather or 277v ballast
- Custom color exterior
- Tamper proof screw (tool available)
- Photo cell

STANDARD FEATURES

- **Construction** Heavy gauge steel
- **Finish** Low gloss black polyester powder coated
- **Diffuser** White UV stabilized textured polycarbonate
- **UL Listed** Wet location
- Mounting hardware & Lamp(s)



MODEL	LAMP	W	D	L
SDW7	7 watt	8 5/8"	2 1/2"	6 11/16"
SDW9	9 watt	8 5/8"	2 1/2"	6 11/16"
SDW13	13 watt	8 5/8"	2 1/2"	6 11/16"
SDW18	2-9 watt	8 5/8"	2 1/2"	6 11/16"
SDW26	2-13 watt	8 5/8"	2 1/2"	6 11/16"



BRIGHTWAY

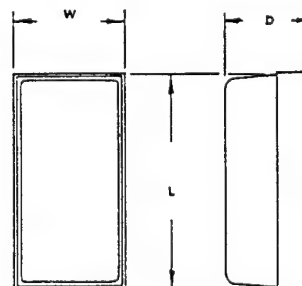
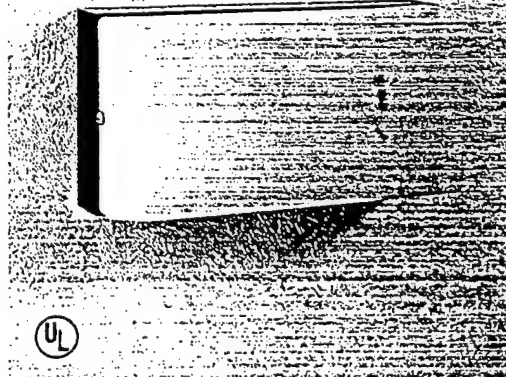
UL Wet Listed for use indoors or out, in wall or ceiling applications. White polycarbonate lens and powder coated steel construction are standard features. Options include Polished Brass finish and Bulkhead style cage.

OPTIONS AVAILABLE

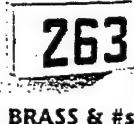
- Clear textured polycarbonate diffuser
- Cold weather or 277v ballast
- Chrome or Polished Brass finish
- 3" letters or numbers (up to 4 digits)
- Bulkhead style cage
- Custom color finish
- Back box with knock-outs or backplate
- Tamper proof screws (tool available)
- Photo cell

STANDARD FEATURES

- **Construction** Heavy gauge steel
- **Finish** Low gloss black polyester powder coated
- **Diffuser** White UV stabilized textured polycarbonate
- **UL Listed** Wet location
- Mounting hardware & Lamp(s)



MODEL	LAMP	W	D	L
BW7	7 watt	4 1/2"	3 1/2"	8 9/16"
BW9	9 watt	4 1/2"	3 1/2"	8 9/16"
BW13	13 watt	4 1/2"	3 1/2"	8 9/16"
BW18	2-9 watt	4 1/2"	3 1/2"	8 9/16"
BW26	2-13 watt	4 1/2"	3 1/2"	8 9/16"



TECHNICAL INFORMATION

ENERGY SAVINGS CALCULATION

(Watts (difference) X hours on per day X days on per year X .001 X utility rate (\$/KWH) = \$\$ saved per year.

Example (75wt - 13wt) X 8 hrs/day X 365 days/yr X .001 KWH X \$.09/KWH = **\$16.25 savings per fixture per year**

GENERAL INFORMATION

Incandescent equivalents are compared with A19 and/or A21 medium base soft-white lamps for wattages up to 150 watts, PS-30 or PS-35 inside frost for 300 and 500 watts, PS-52 inside frost for 750 watt.

AVERAGE LAMP LIFE

Rated average lamp life for incandescent is 750 - 1000 hours.

Average life for Fluorescent lamps is based upon a minimum 3 hours per start on ballast which meet ANSI Standards for that lamp.

Average lamp life for High Pressure Sodium and Metal Halide is based upon minimum 10 hours per burn cycle. Burning cycles shorter than 10 hours per start, the median life will be shortened:

Shrs/start - approx 75% life

2 1/2hrs/start - approx 56% life

1 1/4hrs/start - approx 42% life

STARTING CHARACTERISTICS

Metal Halide and HPS lamps - Full light output does not occur immediately when power is applied to cold lamps. There is a time delay of 2 to 4 minutes before the lamps reach 90% of their full light output.

Fluorescent lamps - Full light output does not occur when the power is applied to cold lamps. Dependent upon ambient temperature, a time delay of 2 to 4 minutes may occur before the lamps reach maximum light output.

RESTARTING CHARACTERISTICS

Metal Halide and HPS lamps - when there is a power interruption of 1/2 cycle or more, HID lamps will extinguish and will not immediately restart when the power is applied. Restarting is dependent on the ballast and starter and may take several minutes before it can start and full light output is reached.

Fluorescent lamps - when power is interrupted, fluorescent lamps will extinguish themselves. Dependent upon ambient temperature and type of ballast driving the fluorescent lamp, restrike time will vary. In most cases only a few seconds is required for restrike with maximum light output within a few minutes.

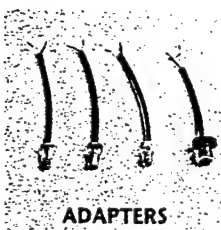
LAMP TYPE	WATT	INITIAL LUMENS	AVERAGE LAMP LIFE	INCANDESCENT EQUIVALENT	INCANDESCENT LUMENS	START TEMP °F
FLUORESCENT						
5 watt - Twin Tube	5	250	10000	26	190	0
7 watt - Twin Tube	7	400	10000	40	490	0
9 watt - Twin Tube	9	600	10000	60	855	25
13 watt - Twin Tube	13	900	10000	75	1170	32
9 watt - Double Twin Tube	9	600	10000	60	855	25
13 watt - Double Twin Tube	13	900	10000	75	1170	32
26 watt - Double Twin Tube	26	1800	10000	100	1710	25
FC679 - Circine	20	875	1200	60	855	32
FC819 - Circine	22	1000	1200	75	1170	32
FC1219 - Circine	32	1910	1200	150	1710	32
F20T12 - Straight Tube	20	1300	9000	100	1710	32
F30T12 - Straight Tube	30	2360	18000	150	2780	32
F40T12 - Straight Tube	40	3200	20000	200	3910	32
HIGH PRESSURE SODIUM						
LU35 - Med Base	35	2250	16000	150	2780	-50
LU50 - Med Base	50	4000	24000	200	3910	-50
LU70 - Med Base	70	6300	24000	300	6110	-50
LU100 - Med Base	100	9500	24000	500	10850	-50
LU150 - Med Base	150	16000	24000	750	17040	-50
METAL HALIDE						
MH35/U - Med Base	35	3400	5000	200	3910	-22
MH70/U - Med Base	70	5600	10000	300	6110	-22
MH100/U - Med Base	100	7800	10000	500	10850	-22
MH150/U - Med Base	150	13500	10000	750	17040	-22

OPTIONS

STANDARD OPTIONAL COLORS



CUSTOM COLORS Consult factory for color match, minimum quantities and set-up charges.



Candelabra base
Bayonette base
Intermediate base
Medium base

Available attached to fixture,
with 6" pigtails, or with
Quick-connects.

UNENCO®

Designers and Manufacturers of Reliable, Common Sense, Energy Conservation Equipment

1993 PRICE LIST

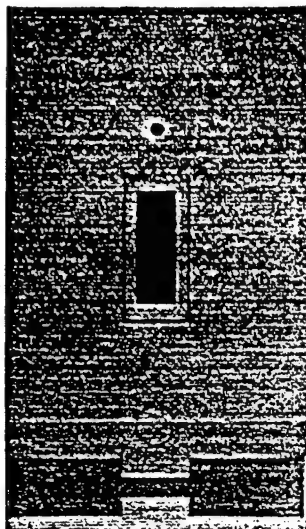
January 1993

Supersedes all previous price lists.

Prices subject to change without notice.

The Most Specified Occupancy Sensor In The Industry

The Only Automatic Light Switch That Looks Like a...



Switch to Everyone!

The model SOM-500-A **Switchomat** can save \$60 per year in a typical office; \$30,000 a year in a 100,000 sq. ft. facility, and is the most specified automatic lighting control in the industry. With its unique, sensitive high density pattern and 20-year, trouble-free life expectancy, the SOM-500-A **Switchomat** is the world's best investment in energy conservation. All UNENCO sensors work with new and existing lighting technologies. And, along with the UNENCO free layout and design service, as with all our products, we offer a 90-day money-back guarantee and up to 5 years warranty.

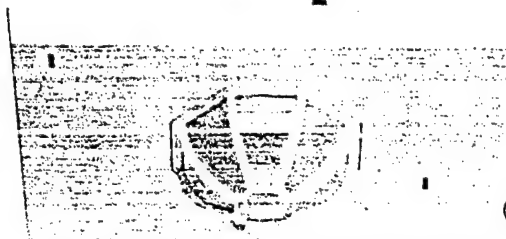
Evaluation Price: \$52.00



Look for the UNENCO lightning bolt for innovative designs and new products!

UNENCO'S NEW and EXCLUSIVE "QUIK-TO-INSTALL"

Tailored  to the needs of the Professional Installer!



PIR-1000-QTI

The "**QUIK-TO-INSTALL**" (**QTI**) is the new industry standard.

With **color-coded**, low voltage connectors and **standard** plenum harness cable lengths the **QTI** is fast and easy to assemble! The PIR-1000-**QTI** occupancy sensor with 360° viewing pattern covers 1,000 square feet. All features of the revolutionary "**QUIK-TO-INSTALL**" are designed to reduce material and labor costs and deliver 100 years of trouble-free performance. Compatible with new and existing lighting technologies.
Evaluation Price: \$74.50
(for complete **QTI** system)

Risk Free Offer

Take advantage of our UNENCO Equipment Evaluation Period policy. Order any of the products on this page and try them for 30 days, risk free! If you are not fully satisfied with their performance, send them back to us within 30 days and pay nothing. UNENCO offers a 90 day money-back guarantee and up to 5 years warranty on all our products. UNENCO has a proven history of quality products, service and performance since 1983.

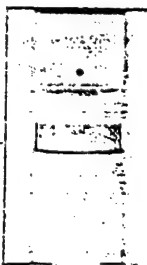
UNENCO, Inc.
Corporate Headquarters
2555 Nicholson Street
San Leandro, CA 94577-4216
510-352-1802 • FAX: 510-895-5753 • 1-800-227-0452

Texas Office:
208-B Industrial Court
P. O. Box 416
Wylie, TX 75098-0416
214-442-5493 • FAX: 214-442-4198 • 1-800-527-7406

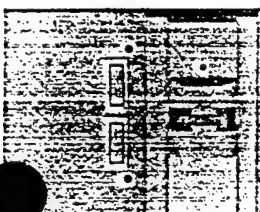
Automatic Wall Light Switches *Switchomat*™ Passive Infrared



SOM-500-A

SOM-1000-A
SOM-1000-B

SOM-1000-A-2

**SOM-500-A**

Switchomat™ Manual lights off switch with built-in safety neon night light. Occupancy sensor, up to 800 sq. ft. coverage. 120/277 Volt, 1000/1800 Watt switching capacity, fluorescent or incandescent. Immediate activation when entering room.

\$78.00	\$60.00	\$56.00	\$52.00
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SOM-1000-A

Switchomat™ Occupancy Sensor, up to 1000 sq. ft. coverage. 120/277 Volt, 1000/1800 Watt switching capacity, fluorescent or incandescent, 180° coverage. Immediate activation when entering room.

84.00	64.00	60.00	56.00
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SOM-1000-B

Switchomat™ Occupancy Sensor, up to 1000 sq. ft. coverage. Single circuit heavy load capacity. Min. 900 Watt to max. 2400 Watt at 120V ballast rating. Min. 1800 Watt to max. 4500 Watt at 277V ballast rating, 180° coverage. Immediate activation when entering room.

97.50	73.00	69.00	65.00
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SOM-1000-A-2

Switchomat™ 2 switches, 2 circuits, occupancy sensor, up to 1000 sq. ft. coverage. 120/277 Volt, 1000/1800 Watt switching capacity on each circuit (2 wires) 180° coverage. Immediate activation when entering room.

93.00	70.00	66.00	62.00
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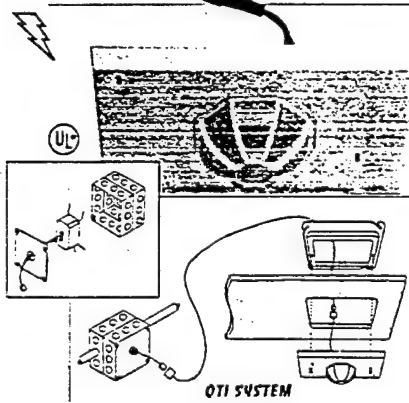
SOM-1200-2-HD

Switchomat™ Tailored specifically for classrooms! 2 switches, 2 circuits, immediate activation sensor with up to 4000 sq. ft., 180° coverage. 120/277V, 2000/4000 Watt switching capacity on each circuit (2 wires). Can be mounted in either double or triple gang wall box or plaster ring.

132.00	96.00	92.00	88.00
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Ceiling-Mounted Passive Infrared *Conserver*™ Occupancy Sensors

The NEW "Quik-To-Install" (QTI) product line can be ordered separately, in any combination to fit any installation need. The color-coded connectors make assembly of a QTI sensor, QTI Plenum Harness Cables and a QTI Power Pack fast and easy!



QTI SYSTEM

PIR-1000-QTI

The PIR-1000-QTI, occupancy sensor. Up to 1000 sq. ft. coverage, 360° high density viewing pattern. Color-coded connectors and standard length approved plenum harness cable makes installation *fast and easy*. For use with QTI Power Pack, 20 amp switching capacity. Saves materials and labor!

78.00	60.00	56.00	52.00
-------	-------	-------	-------

PIR-2000-QTI

The PIR-2000-QTI, occupancy sensor. Up to 2000 sq. ft. coverage, 360° high density viewing pattern. Color-coded connectors and standard length approved plenum harness cable makes installation *fast and easy*. For use with QTI Power Pack, 20 amp switching capacity. Saves materials and labor!

112.50	85.00	80.00	75.50
--------	-------	-------	-------

**PIR-1000-P
Conserver**™

Self contained occupancy sensor. Up to 1000 sq. ft. coverage. 360° high density viewing pattern.
Specify voltage when ordering.

93.00	68.00	64.00	62.00
-------	-------	-------	-------

**PIR-2000-P
Conserver**™

Self contained occupancy sensor. Up to 2000 sq. ft. coverage. 360° high density viewing pattern.
Specify voltage when ordering.

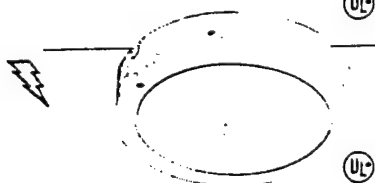
127.50	95.00	90.00	85.00
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Ceiling-Mounted Ultrasonic Conserver® Occupancy Sensors

All Ceiling-Mounted occupancy sensors can automatically control the On/Off for lighting and HVAC.

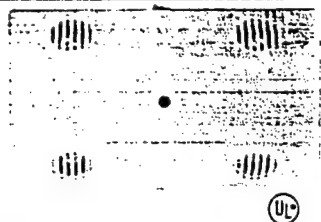


C-500-2000-QTI \$132.00 \$98.00 \$93.00 \$88.50
Up to 2000 sq. ft. coverage occupancy sensor. Color-coded connectors for easy identification. For use in large open offices. Also suitable for long hallways, 100' x 15'. For use with QTI Power Pack and harness cables.



C-500-1000-QTI 118.00 88.00 83.00 78.50
Up to 1000 sq. ft. coverage. For use with QTI Power Pack and harness cables.

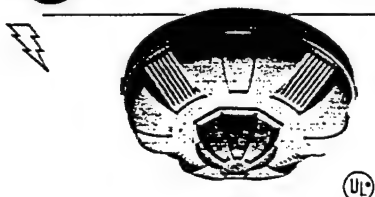
C-600-R-QTI Conserver® 91.50 69.00 65.00 61.50
Up to 600 sq. ft. coverage. Equipped with versatile transmitter power slide switch feature for use in small rooms. For use with QTI Power Pack and harness cables.



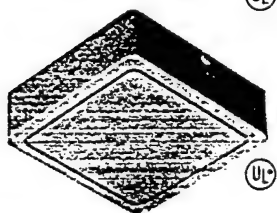
C-500-2000-P Conserver® 148.50 109.00 104.00 99.00
Self contained, 2000 sq. ft. coverage sensor for multiple unit installations in large open offices. Also suitable for long hallways, 100' x 15'. *Specify voltage when ordering.*

C-500-1000-P Conserver® 143.50 104.00 99.00 94.00
Self contained up to 1000 sq. ft. sensor. *Specify voltage when ordering.*

Combination Ultrasonic and Passive Infrared / Specialty Occupancy Sensors

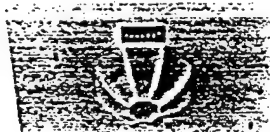


Combo Sensor QTI 145.00 112.50 104.50 102.00
"Combo"
Dual technology occupancy sensor combines both ultrasonic and passive infrared for those specifiers who cannot take any chances. Built in light level sensor for additional savings where feasible. For use in large offices where small motion detection is vital.



HVAC Control Conserver®
HMS-1 103.50 78.00 73.00 69.50
HVAC control for offices, Hotel/Motel guest rooms up to 400 sq. ft. with built-in fresh air comfort cycle timer.

Photoelectric Controller Automatic Light Level Controls



DAYLIGHT TRACKER DT 63.00 50.00 46.00 42.00
Measures ambient daylight levels, then automatically activates lights only when lighting is necessary. Factory calibrated foot candle level settings, adjustable with unique "dip switch". No more guesswork.

Anytime Calibration

DAYLIGHT TRACKER DT-D 63.00 50.00 46.00 42.00
Measures ambient daylight levels, then automatically dims to preset light levels. To be used with I. C. Controllable Electronic Ballast.



DAYLIGHT TRACKER DT-P 78.00 60.00 56.00 52.00
Self-contained, measures ambient daylight levels. 20 amp switching capacity. *Specify voltage when ordering.*

January 1993

Supersedes all previous price lists
Prices subject to change without notice

LIST PRICE 1-23 UNITS 24-95 UNITS 96 UNITS and Up.

Power Switch Packs / Accessories

Model 211-QTI

120V Power/Switch Pack with isolated relay contacts and color-coded connectors. 20 AMP ballast rating. 40 year life expectancy at full load. *Heavy duty power packs for motor loads available upon request.*

\$27.75 \$22.00 \$20.00 \$18.50

Model 212-QTI

208/240V Power/Switch Pack with isolated relay contacts and color-coded connectors. 20 AMP ballast rating. 40 year life expectancy at full load. *Heavy duty power packs for motor loads available upon request.*

27.75 22.00 20.00 18.50

Model 213-QTI

277V Power/Switch Pack with isolated relay contacts and color-coded connectors. 20 AMP ballast rating. 40 year life expectancy at full load. *Heavy duty power packs for motor loads available upon request.*

27.75 22.00 20.00 18.50

QTI 15' Plenum Harness Cable

UL approved plenum harness cable with color-coded connectors. Makes a QTI occupancy sensor and QTI Power Pack installation *fast and easy.*

7.00 5.00 4.50 4.00

QTI 20' Plenum Harness Cable

UL approved plenum harness cable with color-coded connectors. Makes a QTI occupancy sensor and QTI Power Pack installation *fast and easy.*

7.50 5.50 5.00 4.50

QTI Splitter S-3M-3F

Used in conjunction with QTI system for multiple sensor, power pack installations.

7.50 6.00 5.50 5.00

DGAP-500

Model SOM-500-A Occupancy Sensor accessory.

4.15 2.75 2.75 2.75

DGAP-1000

Model SOM-1000 Occupancy Sensor accessory.

4.15 2.75 2.75 2.75

RRU

Remote Relay Unit for switching additional circuits or can be used as interface for HVAC controls since contacts are isolated. For use with self-contained "P" version units. 20 AMP switching capacity, 1 to 1.5 HP, 4 wire connection. *Specify voltage when ordering.*

30.00 24.00 22.00 20.00

Double Gang Adapter Plate
Model DGAP-500

SCREWS (4)

Double Gang Adapter Plate
Model DGAP-1000

SCREWS (4)

PLASTIC CAPS
(2 PLACES)

PLASTIC CAPS
(2 PLACES)

UL

TERMS AND CONDITIONS

Payment Terms

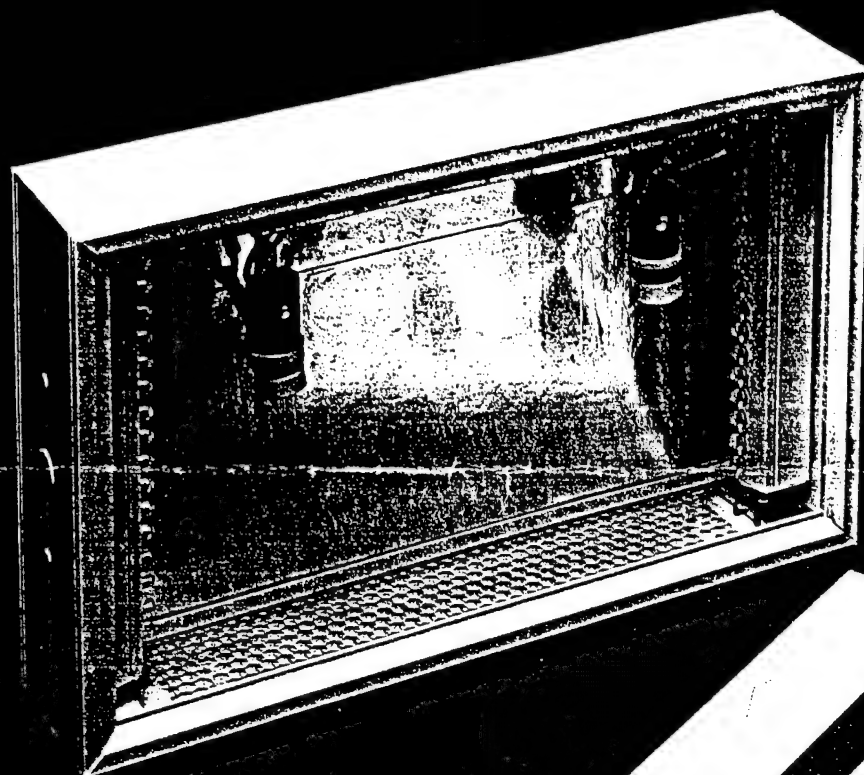
2% cash discount if paid 10 days from date of invoice or on any COD shipment. Net 30 days after date of invoice. Sales tax added to California and Texas unless resale number is provided. Minimum order \$100.00. On any order below \$100.00 a \$10.00 service charge for shipping and handling will be added. Prices subject to change without notice. Past due accounts accrue 1.5% charge per month.

Weight

Weight FOB San Leandro, CA, USA.

Hawaii, Puerto Rico and Alaska charges will be added to invoice. Next day delivery UPS red charges will be added to invoice. Second day delivery UPS blue charges will be added to invoice.

10-40



EXIT

After more than 25 years of supplying quality emergency lighting products to fixtures manufacturers, AstraLite® has designed a revolutionary new light source which we couldn't pass up offering directly to you through distribution — the AstraLite 2000.

Our new technology provides an innovative way to upgrade your existing exit signs using light-emitting diodes (LEDs). The AstraLite 2000 reduces energy costs by up to 96% and can pay for itself in about six months — then the savings flow into

your bottom line for its remaining 80-100 years of virtually maintenance-free operation. Most importantly, you gain peace of mind that the continuously lighted word EXIT ensures safety during an emergency — and compliance with codes, fire marshals, insurance companies and the public.

AstraLite is ready to help you virtually eliminate the energy and maintenance costs and hassles associated with keeping your exit signs lighted. To learn more about the numerous benefits of upgrading your exit signs, call (800) 832-LITE.

Comparison Chart 1 year	Light Source Life	Annualized Product Replacement Cost	Annual Energy Cost ¹	Annual Maintenance Cost ²
Incandescent (Two 20-watt bulbs)	3,000 hrs.	\$16.06 ³	\$35.04	\$24.33
Compact fluorescent (One 9-watt bulb with 3-watt ballast adapter)	10,000 hrs	\$10.00 ⁴	\$10.51	\$8.33
AstraLite 2000 (1.8-watt unit)	80-100 yrs. (700,800-876,000 hrs.)	\$0.00	\$1.58	\$0.00

¹ Based on utility kilowatt-hour rate of 10c.

² Based on 25 minutes to replace bulb(s) at \$20.00 per hour.

³ Based on bulb cost of \$2.75.

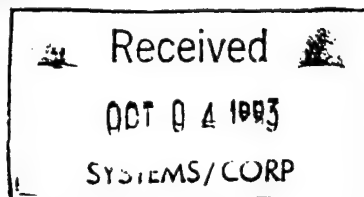
⁴ Based on one replacement per year plus ballast replacement every three years.



Astralite
PO Box 476 Annandale, NJ 08801-0476
(800) 832-LITE (908) 735-0232
Patent Applied

River City Reflector Company

1043 South Cooper Street
Memphis, Tennessee 38104
(901) 274-8200



PRICE LIST 9/1/93

ASTRALITE LED EXIT RETROFIT KITS

SINGLE FACE	120V	With Socket Adapters *	39.95 ea
DOUBLE FACE	120V	With Socket Adapters *	59.95 ea

* SPECIFY SOCKET TYPE: (MED, D.C., INTERMEDIATE, CANDELABRA)

SINGLE FACE	120V	Direct Wire/Snap-Connect	36.95 ea
DOUBLE FACE	120V	Direct Wire/Snap-Connect	56.95 ea

SINGLE FACE	277V	AVAILABLE IN DIRECT WIRE ONLY	42.95 ea
DOUBLE FACE	277V	AVAILABLE IN DIRECT WIRE ONLY	56.95 ea

REPLACEMENT DIFFUSER (IF NECESSARY) 8.00 EA
(BRIGHT RED)

1. Kits contain LED light sticks, 2 quick-connect socket adapters, or Direct Wire Snap-Connectors, Reflective adhesive tape, and wire ties.
2. Minimum Order 12 kits. Adapter types can be mixed.
3. Terms 1% 10, Net 30
4. Freight allowed on orders of \$ 1500 or more
5. Deduct 5% from price listed above on Purchases of 96 or more units.

facility

Cogeneration Plant At Building 168

Rock Island Arsenal, Illinois

project coordinator for using service

David Osborn

functional requirements summary, PDB-1

11-1

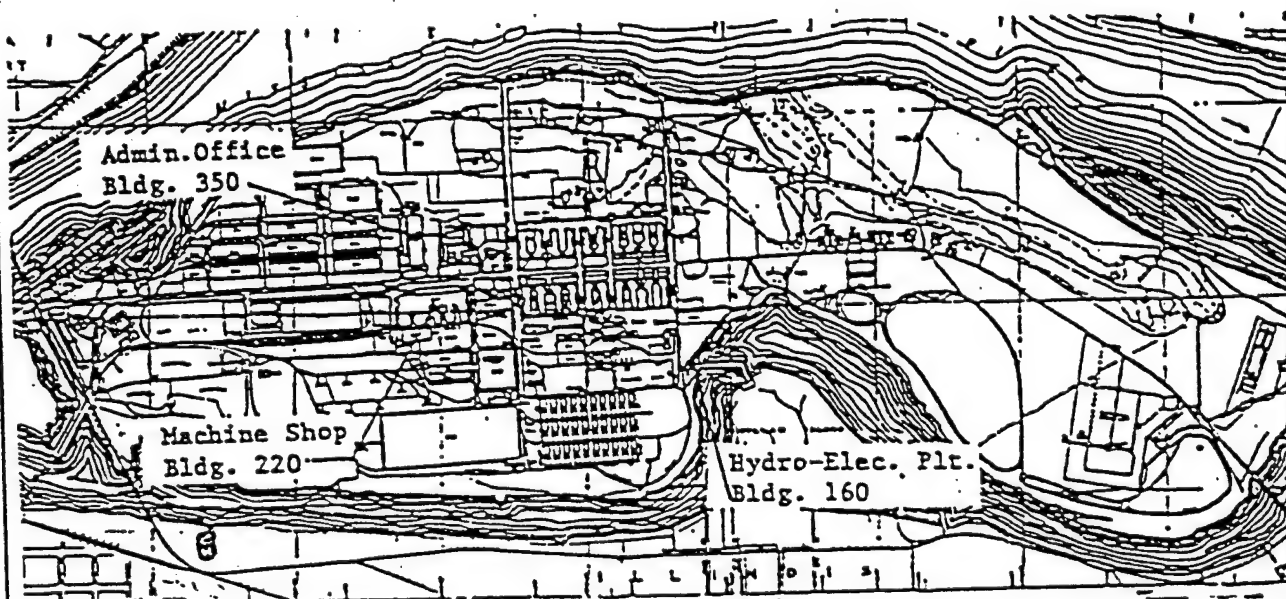
OBJECTIVE:

The objective of this project is to install a cogeneration plant consisting of four dual-fuel, natural gas/diesel turbine-generators to produce electricity and steam for the Arsenal.

functional requirements summary, PDB-1

11-2

U. S. ARMY
ROCK ISLAND ARSENAL, ILLINOIS



facilities requirements sketch, PDB- 1/2

11-3

APPENDIX C
DOCUMENTATION CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
A-1	Cost estimates for each primary and supporting facility	NR			
A-2	Telecommunications system coordination with USACC and authorization for exceptions	NR			
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse coordination, etc.)	R	A		
A-4	Assignment of airspace	NR			
A-5	Economic analysis of alternatives	R	D		
A-6	Approval for new starts	NR			
A-7	International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)	NR			
A-8	Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	R	A		
A-9	Exceptions to established criteria	NR			
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)	R			
A-11	Identification of related or support projects (so projects can be coordinated)	R			
A-12	Required completion date	R			
Other Special Considerations (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*** BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

11-5

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Consultation with the District Office to determine and evaluate flood plain hazards	NR			
B-2	Preparation, submission, and/or approval of new	NR			
(A)	General Site Plan	NR			
(B)	Annotated General Site Plan	NR			
(C)	Sketch Site Plan	NR			
(D)	Facilities Requirements Sketch	NR			
B-3	Preparation of	NR			
(A)	Site Survey	NR			
(B)	Subsoil information	NR			
B-4	Approval by Department of Defense Explosive Safety Board (DDESB) for Safety Site Plan	NR			
	Other Site Development Considerations (List and number items)				
	1. See Project Development Brochure, PDB-1/2				

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***BY WHOM** (Check and insert appropriate letter)

- A — DFAE
- B — Using Service
- C — Construction Service
- D — Designer
- E — Other (Check Comments Attached and explain)

documentation checklist

11-6

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	R	D		1
C-3	Approval for removal and relocation of existing useable facilities	R	B		
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with Installation where sited	NR			
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item B-4)	NR			
C-18	Analysis of deficiencies	R	D		1
C-19	Consideration of alternatives	R	D		2
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-built drawings for alterations or additions	R	C		
C-22	Availability of Standard Design or site adaptable designs	NR			
Other Architectural & Structural (List and number items)					
1. See Supplemental Data Detailed Project Justification Paragraph D3.					
2. See Supplemental Data Detailed Project Justification Paragraph D4.					

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***BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

11-7

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
D-1	Fuel considerations and cost comparison analysis	R	D		
D-2	Energy requirements appraisal (ERA)	R	D		I
D-3	Conformance with DOD Energy Reduction requirements	R	D		
D-4	Evaluation of existing and/or proposed utility systems	R	D		
Other Mechanical and Utility Systems (List and number items)					
1. See Special Requirements, Paragraph 3 (SRP-3)					

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A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

11-8

E. ENVIRONMENTAL CONSIDERATIONS

ITEM

E-1	Environmental impact assessment
E-2	EIA conclusions require Environmental Impact Statement
E-3	Determination of health, environmental or related hazards. Assistance to determine existence of any health, environmental or related hazard may be requested from Aberdeen Proving Ground, MD 21010, the Office of the Surgeon General, Attn: DASG-HCH (Army Environmental Hygiene Agency)
E-4	Air/water pollution permit, coordination with agencies and compliance with standards at Federal, state and local level
E-5	Corrective measures associated with Environmental Impact Statements or assessment—list separately and evaluate.
	Other environmental considerations (list and number items)
	<ol style="list-style-type: none"> 1. See Supplemental Data Detailed Project Justification Paragraph D9.

Required or Not Required	To Be Determined	Comment Attached	Document Attached
R	D		1
NR			
NR			
R	D		
NR			

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* BY WHOM (Check and insert appropriate letter)

A - DFAE

B → Using Service

C – Construction Service

D - Designer

E - Other (Check Comments Attached and explain)

documentation checklist

11-9

APPENDIX D
TECHNICAL DATA CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
A-1	Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area average	NR			
A-2	Construction phasing requirements	R	D		
A-3	Functional support equipment (mechanical, electrical, structural, and security) to be built in	R	D		
A-4	Equipment in place and justification	NR			
A-5	Other equipment and furniture (D&MA, OPA) and costs	NR			
A-6	Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.)	NR			
A-7	Type of construction (permanent, temporary, semi-permanent)	NR			
A-8	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.	NR			
Other special considerations (list and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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*BY WHOM (Check and insert appropriate letter)

A — DPAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

11-11

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Construction restrictions or guidelines pertaining to site access and preferred construction routes	R	A		
(A)		NR			
(B)	Airfield clearance, explosive storage, working hours, safety, etc.				
(C)	Facilities and/or functions or adjoining areas (structures, materials, impact)	NR			
B-2	Real estate actions (acquisition, disposal, lease, right-of-way)	NR			
B-3	Demolition/relocation required (data)				
(A)	Special considerations due to explosives/radioactivity/chemical contamination/asbestos emissions/toxic gases	NR			
(B)	Restrictions on disposal of demolished/relocated material including hazardous waste	NR			
B-4	Pavement types and requirements (including traffic surveys and MTMC coordination)	NR			
B-5	Landscape considerations				
(A)	Protection of existing vegetation	NR			
(B)	Stockpile topsoil	NR			
Other Site Development (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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***BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

11-12

C. ARCHITECTURAL & STRUCTURAL

ITEM	
C-1	Vibration-producing equipment requiring isolation
C-2	Seismic zone and other design load criteria (typhoon, hurricanes, earthquake loads, high or low loss potential)
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)
C-5	Designation and strength of units to be accommodated
C-6	Requirements and data for special design projects
C-7	Unusual floor and roof loads (safes, equipment)
C-8	Security features (arms rooms, vaults, interior secure areas)

Other Architectural & Structural (List and number items)

Required or Not Required	To Be Determined	Comment Attached	Document Attached
R	D		
R	D		
NR			
NR			
NR			
NR			
R	D		
NR			

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***BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

11-13

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	* To Be Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	R	D		
D-2	Special peak usage periods and peak leveling techniques	R	D		
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	D		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	R	D		
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	R	D		
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	R	D		
D-10	Solar energy evaluation	NR			
Other Mechanical & Utility Systems (List and number items)					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*** BY WHOM** (Check and insert appropriate letter)

- A — DFAE
- B — Using Service
- C — Construction Service
- D — Designer
- E — Other (Check Comments Attached and explain)

technical data checklist

11-14

E. ENVIRONMENTAL CONSIDERATIONS

ITEM

E-1 Waste water treatment, air quality, and solid waste disposal criteria
Other Environmental Considerations (List and number items)

Required or
Not Required

To Be
Determined

Comment
Attached

Document
Attached

R

D

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

BY WHOM (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

technical data checklist

11-15

F. FIRE PROTECTION

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
F-1	Special fire protection systems or features (detection and suppression equipment, hazards, etc.)	R	D		
	Other Fire Protection Considerations (List and number items)				

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*** BY WHOM** (Check and insert appropriate letter)

- A — DFAE
- B — Using Service
- C — Construction Service
- D — Designer
- E — Other (Check Comments Attached and explain)

technical data checklist

11-16

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA			2. DATE 1 November 93	
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		4. PROJECT TITLE COGENERATION PLANT AT BUILDING 168			
5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER ECIP #3	8. PROJECT COST (\$000) \$16,199		
9. COST ESTIMATES ¹					
ITEM		U/M	QUANTITY	UNIT COST	COST (\$000)
Primary Facility					
Interior Light Fixtures and Controls		Lot	1	14,727,000 ²	14,727
Subtotal					14,727
Design (5%)					736
Total Contract Cost					15,463
Supervision, Inspection and Overhead (5%)					736
Total Request					16,199
<p>10. DESCRIPTION OF PROPOSED CONSTRUCTION</p> <p>The Arsenal currently purchases electricity from the local utility and operates an on-site coal-fixed steam plant which reproduces steam for both process loads and heating loads. The installation of four 6 MW natural gas/diesel turbine generators will allow the Arsenal to produce all electricity on-site. By recovering heat from the turbines, steam can be generated to displace a large portion of coal currently used to generate steam. This heat recovery process will also allow the existing steam plant to be shut down for 3-4 months in the summer. The implementation of this project will save 706,000 MBtu/Yr of electricity (site). The first year dollar savings is \$2.84 million.</p> <p>11. REQUIREMENT</p> <p>Project: The proposed project will install a 24 MW cogeneration facility in Building 168.</p> <p>Requirement: The project is required to reduce the energy consumption and to comply with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759. The proposed project will reduce annual electrical consumption by 706,000 MBtu/Yr and annual energy cost by \$3.3 million.</p> <p>Current Situation: The Arsenal currently purchases electricity from the local utility and operates an on-site coal-fired steam plant which produces steam for both process loads and heating loads.</p>					
<p>¹See Attached Detail Cost Estimate</p> <p>²Cost Has Been Escalated to Midpoint of Construction</p>					

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA		2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois			
4. PROJECT TITLE COGENERATION PLANT AT BUILDING 168		5. PROJECT NUMBER ECIP #3	
<p>Impact if not provided: If the proposed project is not funded, a reduction of 706,000 MBtu/Yr in electrical energy cannot be achieved, and excessive amounts of energy will continue to be used. There will be no contribution to energy reduction goals established for United States Army facilities by Army Headquarters.</p>			
<p style="text-align: center;">_____ Colonel, USA Commanding</p>			
ESTIMATED CONSTRUCTION START:		September 1994	INDEX: 4.3%
ESTIMATED MIDPOINT OF CONSTRUCTION:		June 1995	INDEX: 3.38%
ESTIMATED CONSTRUCTION COMPLETION:		March 1996	INDEX:
DETAILED JUSTIFICATIONS			
D1. GENERAL			
<p>The proposed project encompasses the energy consumption of the Arsenal. The project will decrease the electrical energy consumption of the Arsenal while providing a source of emergency power for Building 350 which is the headquarters for the Armament, Munitions and Chemical Command (AMCCOM), and has the critical function of being the National Center for Ammunition Management and Distribution.</p>			
D2. ACCOMMODATIONS NOW IN USE:			
<p>The Arsenal currently purchases electricity from the local utility with no provisions for emergency back-up power for the AMCCOM Headquarters (Building 350).</p>			
D3. ANALYSIS OF DEFICIENCY:			
<p>The Arsenal currently purchase electricity from the local utility with no provisions for emergency power for Building 350. By installing the on-site cogeneration facility, prime power is provided to Building 350 locally, while the local utility tie-in remains to provide emergency power. The installation will provide electrical energy savings of 706,000 MBtu/Yr and Cost Savings of \$2.84 million.</p>			

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
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<p>D4. CONSIDERATION OF ALTERNATIVES:</p> <p>The only alternatives to proposed project are to install emergency generators for Building 350 at a cost of \$4 million. This alternative would provide no energy savings or cost savings to the Arsenal.</p> <p>D5. CRITERIA FOR PROPOSED PROJECT:</p> <p>The proposed project will conform will all applicable federal and United States Army Regulations.</p> <p>D6. PROGRAM FOR RELATED EQUIPMENT:</p> <p>No equipment funded from appropriations other than MCA are required.</p> <p>D7. DISPOSAL OF PRESENT ASSETS:</p> <p>No assets will be disposed.</p> <p>D8. SURVIVAL FACILITIES:</p> <p>The proposed project is not suitable for inclusion of protective shelters.</p> <p>D9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES:</p> <p>The proposed project has been analyzed and will not adversely impact the environment. Energy savings resulting from the project will conserve natural resources.</p> <p>D10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS:</p> <p>It has been determined that these facilities are not located in a flood plain and they do not encroach on wetlands.</p> <p>D11. ECONOMIC JUSTIFICATION:</p> <p>The proposed project qualifies under ECIP Guidelines in AR-415-15. SIR for the project is 1.02 with a simple payback of 5.7 years.</p> <p>See Economic Analysis, SRP-1</p>		

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<p>D12. UTILITY AND COMMUNICATION SUPPORT:</p> <p>A. No related utility support projects are programmed. The project will require modification of existing natural gas and electric utilities serving the Arsenal.</p> <p>B. No telecommunication support is required.</p> <p>D13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES:</p> <p>The project involves the installation of equipment within existing buildings. Review procedures have been implemented for this project in accordance with 36 CFT 800.</p> <p>D14. PROJECT DEVELOPMENT BROCHURE (PART 1):</p> <p>A Project Development Brochure was prepared on 1 November 93 and is attached as a part of the programming documentation.</p> <p>D15. ENERGY REQUIREMENTS:</p> <p>The proposed project will reduce present electrical energy consumption by 706,000 MBtu/Yr at a cost savings of \$2.84 million. See Energy Requirements Appraisal (ERA) in Special Requirements, Paragraph 3 (SRP-3).</p> <p>D16. PROVISION FOR THE HANDICAPPED:</p> <p>No provisions for the handicapped will be made since the scope of the project is in no way applicable to designing for the handicapped.</p> <p>D17. REAL PROPERTY MAINTENANCE ACTIVITY (RPMA) ANALYSIS:</p> <p>A. Physical impact: No new structures will be added.</p>		

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93										
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois												
4. PROJECT TITLE COGENERATION PLANT AT BUILDING 168		5. PROJECT NUMBER ECIP #3										
<p>B. Operations and Maintenance (O&M) impact:</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;"><u>YEAR</u></th> <th style="text-align: center;"><u>O&M</u> <u>NET CHANGE (\$000)</u></th> </tr> </thead> <tbody> <tr> <td>1994</td> <td style="text-align: right;">(430,000)</td> </tr> <tr> <td>(BOD)</td> <td style="text-align: right;">(430,000)</td> </tr> <tr> <td>1995</td> <td style="text-align: right;">(430,000)</td> </tr> <tr> <td>1996</td> <td style="text-align: right;">(430,000)</td> </tr> </tbody> </table> <p>C. Backlog of Maintenance and Repair (BMAR) impact:</p> <p>There will be a decrease in BMAR due to the shut-down times at the existing steam plant.</p> <p>D18. COMMERCIAL ACTIVITIES:</p> <p>The proposed project is not a "New Start Expansion" as defined by DA Circular 235-1. The project has been reviewed in light of the requirements of commercial and industrial facilities. It has been determined that whereas the project does not affect commercial facilities, the requirements of DA Circular 235-1 does not apply.</p>			<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>	1994	(430,000)	(BOD)	(430,000)	1995	(430,000)	1996	(430,000)
<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>											
1994	(430,000)											
(BOD)	(430,000)											
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1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 1 November 93
3. INSTALLATION AND LOCATION Rock Island Arsenal, Illinois		
4. PROJECT TITLE COGENERATION PLANT AT BUILDING 168		5. PROJECT NUMBER ECIP #3

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$ 14,340,000 ³
B. SIOH	\$ 717,000
C. DESIGN COST	\$ 717,000
D. TOTAL COST (1A+1B+1C)	\$ 15,774,000
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$ 0
F. PUBLIC UTILITY COMPANY REBATE	\$ 0
G. TOTAL INVESTMENT (1D-1E-1F)	\$ 15,774,000

Economic Life 20 Yrs

2. ENERGY SAVINGS(+)/COST(-): **OCTOBER 1992**

DATE OF NISTIR 85-3273X USED FOR DISCOUNT FACTORS

ENERGY SOURCE	COST \$/MBTU (1)	SAVINGS MBTU/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	\$ 8.53	\$ 717,500	\$ 6,121,000	13.81	\$ 84,527,000
B. DIST	\$	\$	\$		\$
C. RESID	\$	\$	\$		\$
D. NG	\$ 3.00	\$ -2,242,400	\$ -6,727,000	18.18	\$ -122,300,000
E. PPG	\$	\$	\$		\$
F. COAL	\$ 2.01	\$ 1,121,200	\$ 2,254,000	15.15	\$ 34,141,000
G. SOLAR	\$	\$	\$		\$
H. GEOTH	\$	\$	\$		\$
I. BIOMA	\$	\$	\$		\$
J. REFUS	\$	\$	\$		\$
K. WIND	\$	\$	\$		\$
L. OTHER	\$	\$	\$		\$
M. DEMAND SAVINGS		\$	\$ 1,628,000	13.59	\$ 22,135,000
N. TOTAL		\$ - 403,600	\$ 3,275,000		\$ 18,500,000

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$ -430,720	
(1) DISCOUNT FACTOR (TABLE A-2)		13.59
(2) DISCOUNTED SAVINGS/COST (3A x 3A1)		\$ -5,853,000

B. NON-RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR (3)	DISCOUNTED SAVINGS/COST (+/-) (4)
a. Cost Avoidance	\$ 4,000,000	1	0.96	\$ 3,840,000
b.	\$			\$
c.	\$			\$
d. TOTAL	\$ 4,000,000			\$ 3,840,000

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2 + 3Bd4) \$ -2,013,000

4. SIMPLE PAYBACK 1G/(2N3 + 3A + 3Bd1/Economic Life): 5.2 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5 + 3C): \$ 16,487,000

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 1.05

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 4.3%

³ Costs are Unescalated

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA		2. DATE 1 November 93
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<p>SPECIAL REQUIREMENTS PARAGRAPH 3 (SRP-3):</p> <p>Energy Requirements Appraisal (ERA)</p> <p>1. Project Description: Install Cogeneration System at Building 168 at Rock Island Arsenal.</p> <p>2. Estimated Energy Consumption: The installation currently purchases 708,000 MBtu/Yr of electricity and 1.1×10^6 MBtu of coal, which can be eliminated by the proposed project. The proposed project will increase natural gas consumption by 2.2×10^6 MBtu/Yr.</p> <p>3. Energy Sources: No new energy sources are required for the proposed project. The use of solar energy for this project is impractical.</p> <p>4. Energy Use Impacts: The proposed project will substantially reduce the consumption of electricity and coal.</p> <p>5. Energy Conservation: The proposed project will reduce annual electrical energy consumption by 706,000 MBtu/Yr with annual energy cost savings of \$3.3 million. The project complies with Army Resources Management Plan (ERMP) and Executive Order 12759.</p> <p>6. Energy Alternatives: The proposed project represents the greatest possible reduction in energy consumption available with current technology.</p> <p>7. Energy Effects: The proposed project provides positive environmental effects. It reduces the current energy consumption effectively, reducing the consumption of non-renewable fuel sources.</p> <p>8. Basis of Approval: Total energy requirements and alternative fuel sources have been considered and included in this appraisal or discarded as applicable.</p>			

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U.S. TURBINE CORPORATION POWER GENERATION SYSTEMS



Gas Turbine-Driven Generator Sets Performance Specifications

USTC Model No.	Prime Mover Model No.	Rating ISO Base (kW)(3)	Heat Rate (Btu/kW-Hr/LHV)(3)	Output ISO (SHP)(3)	Pressure Ratio	Turbine Speed (rpm)	Turbine Inlet Temp. (Deg. F)	Exhaust Temp. (Deg. F)(3)	Exhaust Flow (Lb/sec)(3)	Dry Weight (Approx.) (Lbs)	LxWxH (Approx.) (Lbs)
UST700	S2A-01	663	16,440	935	9.0	31,500	1,706	930	10.4	28,500	15x7.6x7.6
UST1200	M1A-11A	1,235	14,617	1,742	9.3	22,000	1,670	858	18.1	33,000	18.4x8.4x8.5
UST1500	M1A-13A	1,472	14,100	2,077	9.4	22,000	1,814	965	17.9	35,000	18.4x8.4x8.5
UST2100	M1A-23	2,042	13,684	2,923	11.2	22,000	2,084	1,067	20.5	38,000	18.4x8.4x8.5
UST2500CC(1)	M1A-13CC	2,365	10,450	3,338	9.4	22,000	1,850	1,056	15.7	35,000	19.5x8.4x8.5
UST3000	M1T-13A	2,861	14,502	4,038	9.4	22,000	1,814	965	35.8	40,000	20x10x8.5
UST3400	501-KB	3,490	12,545	4,711	9.3	14,200	1,800	976.6	34.1	65,500	27x8x7.8
UST3800	501-KB5	3,878	12,182	5,314	9.3	14,400	1,895	1,036.2	34.9	54,000	27.5x7.5x9.3
UST4000	501-KB5S	4,049	12,073	5,546	9.3	14,440	1,935	1,083.7	34.9	54,000	27.5x7.5x9.3
UST4600	570-KA	4,612	12,195	6,539	12.1	11,500	1,477(4)	1,048.8	41.0	76,300	30.8x10x8.5
UST5000	501-KB7	4,892	11,209	6,575	13.5	14,600	1,975	995	44.6	64,000	28x8x9.5
UST5700	571-KA	5,588	10,650	7,923	12.7	11,500	1,477(4)	992.8	43.3	76,300	30.8x10x8.5
UST6000CC(1)	501-KH5	6,620	8,938	9,068	17.1	14,600	1,895	1,030	41.09	79,800	39x10x10
UST12000	MF-111A	12,760	11,210	17,820	12.8	9,660	2,282	1,013	105.7	319,000	48x12x12
UST15000	MF-111B	14,730	10,980	20,570	14.7	9,660	2,282	982	122.9	320,000	48x12x12
UST18000(2)	MF-111AB	16,880	9,955	23,570	12.8	9,660	2,282	1,027	105.7	320,000	48x12x12
UST14000	LM1600	13,500	9,500	18,750	22.0	7,000	1,380(4)	900	99	168,500	50x12.5x11
UST23000	LM2500	22,215	9,405	30,400	18.4	3,600	1,495(4)	982	148	230,000	62x12.5x11
UST35000	IM5000	34,700	9,200	45,600	28.8	3,600	2,120	811	280	456,000	69x12x13
UST26000	STIG-LM2500	25,400(5)	9,000	34,760	20.1	3,600	1,475(4)	939	149	245,000	62x12.5x11
UST50000	STIG-IM5000	49,100(5)	8,180	67,190	28.8	3,000			314	476,000	69x12x13
UST52000	STIG-IM5000	50,900(5)	7,850	69,650	28.8	3,600			314	476,000	69x12x13

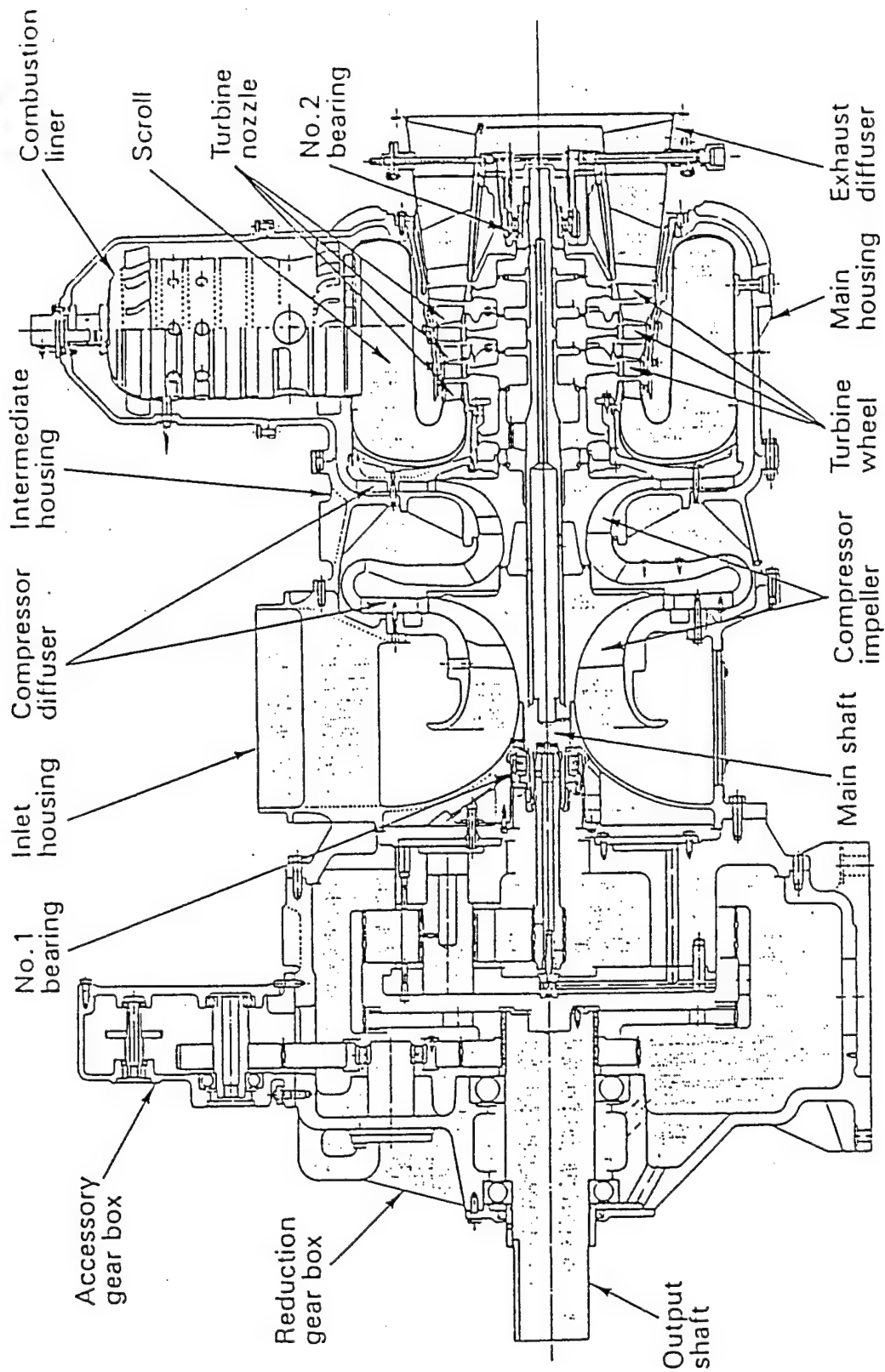
(1) Indicates fully steam injected (Cheng Cycle system optimization).

(2) Indicates fully steam injected.

(3) Ratings are at sea level, gas fuel (LHV), 59 deg. F, no external pressure losses.

(4) Power turbine inlet temperature.

(5) Includes 4"/10" H2O duct losses.



INTRODUCTION

U.S. Turbine Corporation operates as a wholly owned subsidiary of Powell Industries, Inc. of Houston, Texas. Powell Industries is one of the nation's largest manufacturers of electrical distribution equipment. This equipment is primarily utilized in large industrial and utility projects that must control and distribute large blocks of electrical power.

Powell Industries purchased U.S. Turbine in March, 1984. U.S. Turbine was originally organized as Turbine Power Systems in 1974. Under Powell, U.S. Turbine has continued with basically the same operations and facility at Maineville, Ohio (Cincinnati Area).

U.S. Turbine is an engineering intensive manufacturer of power generation equipment for the cogeneration, oil and gas and standby power industries. Our broad product base and commitment to quality has made U.S. Turbine a leader in packaged power generation systems. U.S. Turbine is a distributor of Allison, Kawasaki and Mitsubishi gas turbines and Cooper Superior reciprocating engines.

U.S. Turbine has been associated with the Allison Division of General Motors Corporation for over fifteen years and recently has delivered:

- * One (1) Model UST3800 generator set utilizing the Allison 501-KB5 turbine for Cincinnati Gas & Electric Company in Trenton, Ohio.
- * Two (2) Model UST5700 generator sets utilizing the Allison 571-KA gas turbines for Tamil Nadu Electricity Board in Narimanam, India.
- * Five (5) Model UST3800 generator sets utilizing the Allison 501-KB5 gas turbine for York Research Corporation in New York.
- * One (1) Model UST5600CC generator set utilizing the Allison 501-KH "Cheng-Cycle" gas turbine for MacDill Air Force Base in Tampa, Florida.
- * One (1) Model UST3800 generator set utilizing the Allison 501-KB5 gas turbine for MacDill Air Force Base in Tampa, Florida.
- * Three (3) Model UST3800 generator sets utilizing the Allison 501-KB5 gas turbine for Exxon in Mobile Bay, Alabama.

Currently in manufacture are:

- * One (1) Model UST3800 generator set utilizing the Allison 501-KB5 gas turbine for Burroughs-Wellcome in Greenville, North Carolina.
- * One (1) Model UST3800 generator set utilizing the Allison 501-KB5 gas turbine for University of Windsor in Windsor, Ontario.
- * One (1) Model UST3800 generator set utilizing the Allison 501-KB5 gas turbine for Bank of America in Los Angeles, California.

B. PACKAGE CONFIGURATION

A major benefit of the package configuration is that of speed stability. The gas turbine rotor, by virtue of its high operating speed, has a rotational inertia well in excess of that of the combined gearbox and electric generator. The single-shaft feature brings this rotational inertia into play in the generation of electricity, causing the unit, when running isolated from a nearly-infinite utility bus, to experience lower speed transients resultant from picking-up or dropping heavy electrical loads than is the case of a genset train driven by a free power turbine or a reciprocating engine.

The gas turbine rotational inertia and power absorption in the compressor section also provide a braking action in the event of the switchgear circuit breakers opening, allowing the equipment train's rise in speed to be easily arrested and returned to its normal value.

The use of a torsionally-soft flexible coupling causes electrical fault-induced generator torque oscillation peaks to be vastly reduced as-received by the speed reducer and gas turbine, further promoting equipment ruggedness.

C. ELECTRIC GENERATOR

The electric generator is of the cylindrical rotor, air-cooled, four-pole, star-connected, brushless type. Antifriction bearings with self-contained lubricant are used, as are a shaft-mounted P.M.G. brushless exciter and class F insulation. Included are a set of stator and excitor heaters, set of stator earthing pads and two resistance temperature detectors imbedded in each of the stator windings.

Continuous-duty generators are rated to ANSI C50.14 standards for base class F total temperatures at full gas turbine output power throughout the site ambient temperature range, at a power factor of 0.80 lagging. Standby units allow incursions into the generator peaking range when at high ambient air temperature.

Regulation of steady-state voltage from no-load to full-load conditions is one-quarter percent; and it is one-half percent or less for the effect of ambient temperatures varying from 40 to 100°F. Transient deviations upon application of 100 percent of rated load to a stabilized unit are no greater than twenty percent, with recovery to within five percent of rated voltage in one second or less.

Fuel System

Configurations available:

- Pipeline natural gas fuel
- #2 Distillate fuel
- Alternate fuels, including low-Btu gas to 450 Btu LHV/SCF.
- Dual fuel, i.e. gaseous or liquid fuel, with automatic change-over ability on-line

The USTC scope of supply in all cases includes control valves, pumps, instrumentation, manifolds and pipework.

Options:

Fuel gas compressor, including capacity control system and pressure regulation
Fuel gas filter
Fuel oil filter
Special ancillary equipment for use of nonstandard fuels.

NOx Abatement Injection System (optional)

Valve train, water pump, and injection-to-fuel flow ratio control, handling user-supplied 10 psig water, for full-load guaranteed NOx emissions of 42 ppmv on natural gas fuel and 65 ppmv on distillate fuel.

Options:

Injected water treatment system.

Starting System

Skid-mounted electric/hydraulic start system with variable-displacement hydraulic pump, AC motor, hydraulic motor, overrunning clutch, hydraulic oil reservoir, instrumentation and protectives. A DC motor provides post-shutdown, slow-roll turning.

Options:

- Pneumatic starting system
Compressor and receiver tanks for pneumatic start system
- DC motor starting system (for non-hazardous locations only), with batteries and chargers.

Instrument Air System

Receiver pipe and distribution tubing.

Options:

Instrument air compressor, regulator and volume bottle.

Compressor Cleaning System

Mixing cart, with quick-disconnect couplings, for shutdown crank/soak cleaning.

STDN.119

Options:

Automated, on-line chemical cleaning system.

Lube Oil System

Shaft-driven positive-displacement main pump, DC motor-driven pre/post lube pump, temperature control valve, outdoor-mounted oil-to-air heat exchanger with 100 percent capacity at the site's maximum ambient air temperature, duplex ten-microns-nominal filters, pressure control valve, low pressure protective switches and supply oil high temperature protection, self-lubricated generator bearings reservoir and vent air/oil separator.

Options:

Shell-and-tube heat exchanger, instead of oil-to-air (fin-fan) type.

Automatic reservoir-fill system

CONTROLS AND ELECTRICAL SYSTEMS

Turbine-Generator
Control

Free-standing, control room-mounted, NEMA 1 panel.

Solid-state, load-sharing speed control and exhaust temperature-limiting governor.

Microprocessor-based sequencer for automated starting, stopping and unit protection.

Visual display unit, providing the vibration monitor, temperature monitor and annunciator.

Pushbuttons, power supplies, status indicators and meters, as required.

Automatic voltage regulator, synchronizer, synchroscope, synch-check relay, meters, load control, voltage control, speed control, switches, transducers and miscellaneous hardware for generator monitoring.

Control system batteries and charger.

Options:

Data acquisition system

Telemetry transmitters

Remote control panel

Engine condition-monitoring system

Power factor controller

Alternative enclosure NEMA ratings

STDN.119

Motor Control Center (optional)	Free-standing, control room-mounted, NEMA 1 modular assembly with 480 VAC motor starters and distribution panels for all loads associated with U.S. Turbine-quoted equipment.
	<u>Options:</u>
	Alternative voltages and frequencies for motors and motor starters.
	M.C.C. supply power transformer, connecting to generator high-voltage bus
	Alternative enclosure NEMA ratings
Switchgear and Surge Cabinet (optional)	Free-standing, control room-mounted, NEMA 1 panel with 5-KV-class 250 MVA fault capacity vacuum circuit breakers for UST1100 and larger packages, 600-volt-class 1600-amp frame air circuit breakers for the UST700 package, utility-type protective relays, CTs and PTs, test terminals and signal lamps.
	On-skid-mounted surge capacitors and lighting arrestors.
	<u>Options:</u>
	Relay line-up to suit the user/utility requirements
	Alternative enclosure NEMA ratings
	Alternative fault rating for circuit breakers
	125 VDC batteries and charger.
	Manual isolation switch
Neutral (optional)	Grounding resistor and transformer.
Generator Interconnect	Neutral-side cubicle with three CTs, prior to the point at which the neutral lines are brought to a single point. Line-side leads with connectors.
	<u>Options:</u>
	Line-side cubicle, with CTs.
Ignition System	Exciter, cable, and high-voltage igniter plug.
Fire Protection	U-V detectors backed-up by thermal rate-of-rise detectors, ventilation air fireshutters, fast-bleed and slow-bleed Halon 1301 bottles meeting NFPA12A standards, control panel-mounted fire system controller with horn and manual-pull station, on-skid beacon and manual-pull station, enclosure gas sensor and control panel-mounted monitor, and explosion-proofing of electrical components within the enclosure gas turbine compartment per National Electric Code class 1, group D division 2 criteria.

STDM.119

Options:

CO₂ extinguishant meeting NFPA12 standards, with illuminated signs to warn of extinguishant release.

Lamp for testing U-V sensors.

Skid Lighting

Vapor-tight AC light fixtures - four (4) in the enclosure's gas turbine compartment, and two (2) in the generator compartment.

Miscellaneous

Generator space heaters, on-skid utility outlet and Electrical associated feeders (within optional MCC).

SERVICES, SPARE PARTS AND TOOLS

Testing

Customer-witnessed mechanical and full-load factory testing of the complete package, less the inlet air filter, HRSG and (if present) fuel gas compressor.

Options:

Engineering tests of the generator at the O.E.M. factory.

Witnessing of component testing at O.E.M. factories.

Shipment

F.O.B. Maineville, Ohio, short-term preserved, crated for transport by truck.

Options:

F.O.B. jobsite terms
Crated for shipment by sea.
Long-term preservation

Field Service

Four person-weeks of on-site installation supervision, training and supervision of commissioning, including travel and living.

Options:

Additional service time
Turnkey installation and commissioning contract.
Contract periodic maintenance
Maintenance supervision and extended warranty contract
On-site performance testing

Special Tools

Gas turbine removal tools and alignment bracket.

Lifting Equipment

Spreader bars and cables, for two-crane lifting of the package.

Spare Parts
(optional)

Startup spares.
Two-years' maintenance and basic insurance spares.
Major insurance spares.

Painting

The gas turbine and exhaust collector casing are covered by insulation blankets. Items other than instruments, high temperature parts, control cabinets, finish-machined surfaces, stainless steel, aluminum and plastic have applied to exterior surfaces an inorganic zinc primer, epoxy intermediate coat, and polyurethane top coat; to interior surfaces a vinyl-alkyd primer and copolymer top coat; and to galvanized surfaces a polyvinyl-butly primer and polyurethane top-coat. Control cabinets receive a sealing primer and high-gloss polyurethane top coat. Back/sub panels are white in color, control cabinet structure interiors and exteriors are gray, control cabinet exterior doors and front panels are oyster gray, and all other components are pearl gray.

Options:

Alternative colors
Use of customer-supplied paint specifications.

Documentation

Five copies of an operation and maintenance manual, including installation drawings, parts lists, specifications, schematic diagrams, wiring diagrams, instructions, vendor's drawings and brochures.

Options:

Additional operation and maintenance manuals
Training manuals
Training videotapes
Non-English-language documentation

U.S. TURBINE CORPORATION

AFTERMARKET CUSTOMER SERVICES

U.S. Turbine Corporation provides the most comprehensive aftermarket service programs in the industry, by offering total package support in the areas of operations, parts, maintenance and engineering services. U.S. Turbine's customer service personnel has extensive experience in power generation and cogeneration equipment, including Allison, Mitsubishi, Kawasaki, Ajax-Superior and General Electric driven equipment.

LOCATION

Corporate Office for the Aftermarket Services is headquartered at the USTC engineering and manufacturing facility just north of Cincinnati, Ohio, with regional offices located to strategically staff major service areas.

North America is divided into three territories, East, West and Central Regions. These regional areas consist of senior field service technicians, engineers, field service technicians and start-up personnel. This approach provides reduced travel cost, prompt response to field requirements and access to special tooling and parts. Service personnel are located in the following areas.

WEST/SOUTHWEST AREA

Area	Regional Office and Personnel Locations
California	Bakersfield, Los Angeles, Modesto and Oakland
Texas	Houston

MIDWEST/CENTRAL AREA

Kentucky	Fort Meyers
Minnesota	Minneapolis
Ohio	Cincinnati, Columbus

EAST REGION

New York	Altamont, Bergen, Clifton, Rochester
Pennsylvania	Philadelphia

Field services are co-ordinated through the Maineville, Ohio office in conjunction with the regional managers.

ST.001

RANGE OF SERVICES

Products and services offered by USTC Aftermarket Services include:

- Inspection and Maintenance (scheduled and emergency)
- Installation Supervision
- Start-Up Service
- Training
- Operations and Advisory Service
- Overhaul Co-ordination
- Spare Parts
- Retrofit Engineering Service
- Maintenance Contracts

These services are defined in the following discussions:

INSPECTION AND MAINTENANCE

Preventative Maintenance and Inspection Services

Aftermarket Services can provide preventative maintenance and inspection service at scheduled intervals, usually every three months or 2000 operational hours. An annual 8000 hour inspection is a more thorough inspection including control calibrations and complete operational simulations to verify unit integrity. Inspection services include the following:

- Engine borescope (maintenance and/or damage assessment)
- Integrity of starting system
- Integrity of turbine, gearbox and generator lube systems
- Integrity of fuel systems (liquid, gas, other)
- Operational integrity of fire protection system
- Integrity of engine/skid control system(s)
- Non Generator set equipment, as requested by customer

A quarterly inspection takes about twenty-four (24) hours to complete, and the annual inspections typically take up to forty (40) hours. During the inspection, routine maintenance functions are also performed, as required. USTC's inspections are the most thorough and complete in the industry.

Initial visit to a new site is to conduct a facility and equipment survey and then develop a site specific inspection plan. This custom-tailored inspection log is generated and reused by each representative visiting the site. This document is not only useful for data collection but for problem identification, trend analysis and performance analysis.

Within the areas of Preventative Maintenance and Inspection Services, several contract/agreement formats can be offered. The formats range from an "as-called", i.e., time and material status, to a fixed priced, pre-scheduled format.



FALLING TREE ENTERPRISES, INC.

January 4, 1994

Mr. Greg Loflin
Systems Corporation
2200 Sutherland Avenue
Suite #306
Knoxville, TN 37919


REF: Gas Price Projection

Dear Mr. Loflin:

In view of recent tariff leveling for pipeline transportation of natural gas and earlier stabilization via high pressure storage, we conclude gas prices to remain somewhat flat in U.S. markets over an extended period. Add these factors to the continued reserve replacement of supplies and restraint in Futures pricing to understand our conviction of modest cost ranges.

Therefore, FTE is basing its investment/production on a price range equal to \$2.00 to \$2.50 over the next five years with only fractional deviations for an even longer period

Sincerely,


C. David Falling
President

CDF/ckf

BLDG. 220 - MACHINE SHOP

QTY

DESCRIPTION

347 1' x 4' PENDANT MT. FIXTURE 2 LAMPS @ 34 WATTS/LAMP STD. MAGNETIC BALLAST
ABOUT 50 FOOTCANDLES REQUIRED

~~148 1' x 4' PENDANT MT. FIXTURE 2 LAMPS @ 115 WATTS/LAMP 100 FOOTCANDLES REQUIRED~~

148 1' x 4' PENDANT MT. FIXTURE 2 LAMPS @ 115 WATTS/LAMP " "
100 FOOTCANDLES REQUIRED

61 1' x 8' PENDANT MT. FIXTURE 2 LAMPS @ 60 WATTS/LAMP " "
30-40 FOOTCANDLES

1455 1' x 8' PENDANT MT. FIXTURE 2 LAMPS @ 110 WATTS/LAMP " "
GENERALLY 75-90 FOOTCANDLES

89 1' x 8' PENDANT MT. FIXTURE 2 LAMPS @ 215 WATTS/LAMP " "
100 FOOTCANDLES

347 2' x 4' LAY-IN MT. FIXTURE 2 LAMPS @ 34 WATTS/LAMP " "
50 FOOTCANDLES

54 1000 W MERCURY VAPOR - 40 FT. MOUNTING HEIGHT
2 ROW PATTERN ~ 15 FT. SPACING
50 FOOTCANDLES

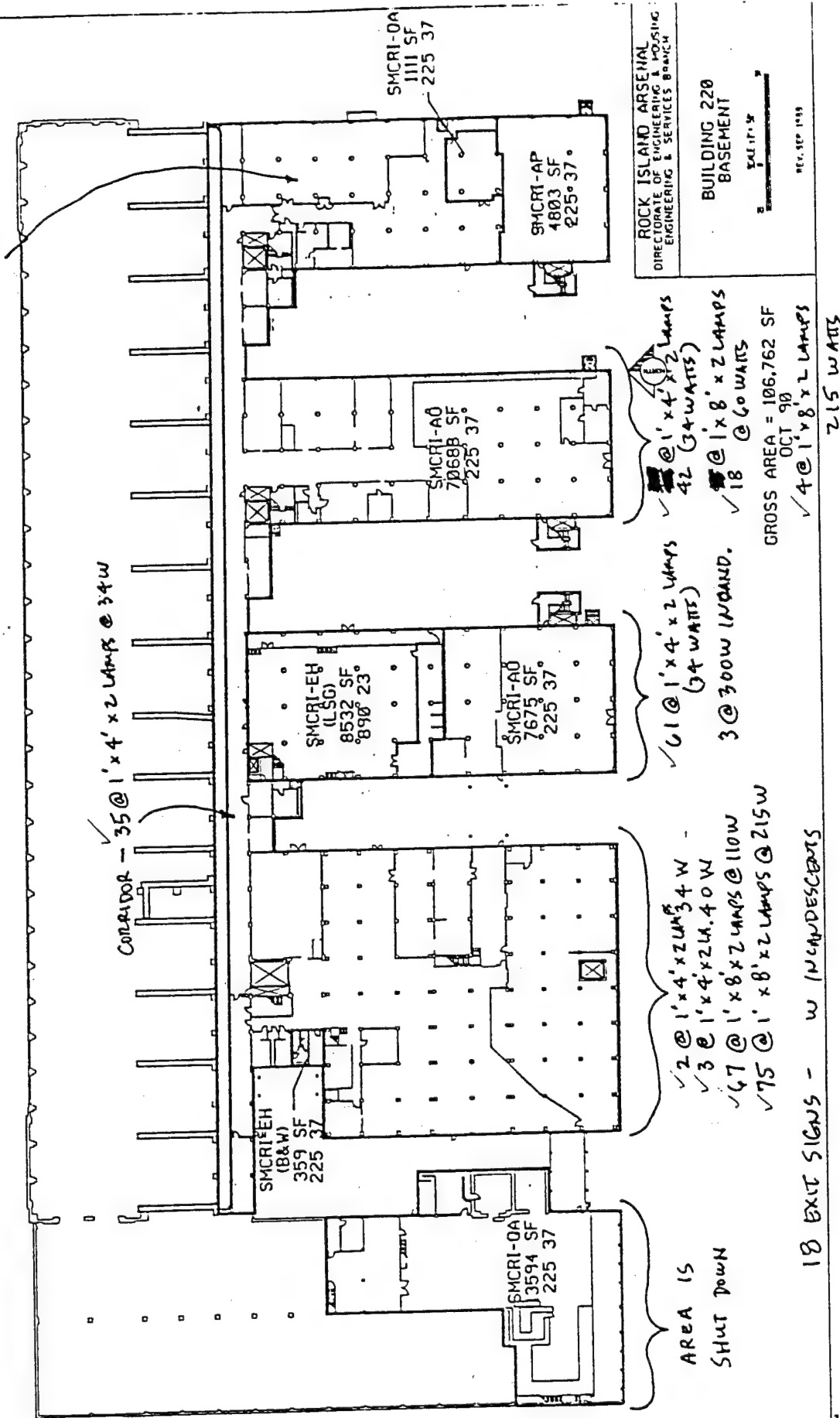
96 450 W MERCURY VAPORS - 40 FT MOUNTING HEIGHT
6 ROW PATTERN ~ 12.5 FT SPACING
50-60 FOOTCANDLES

8 750 W MERCURY VAPORS - 25 FT. MOUNTING HEIGHT
(THESE ARE UNDERNEATH CRANE BOOMS)
50-60 FOOTCANDLES

Title	Checked By	Date
	Prepared By	Sheet No.
Project	Job No.	

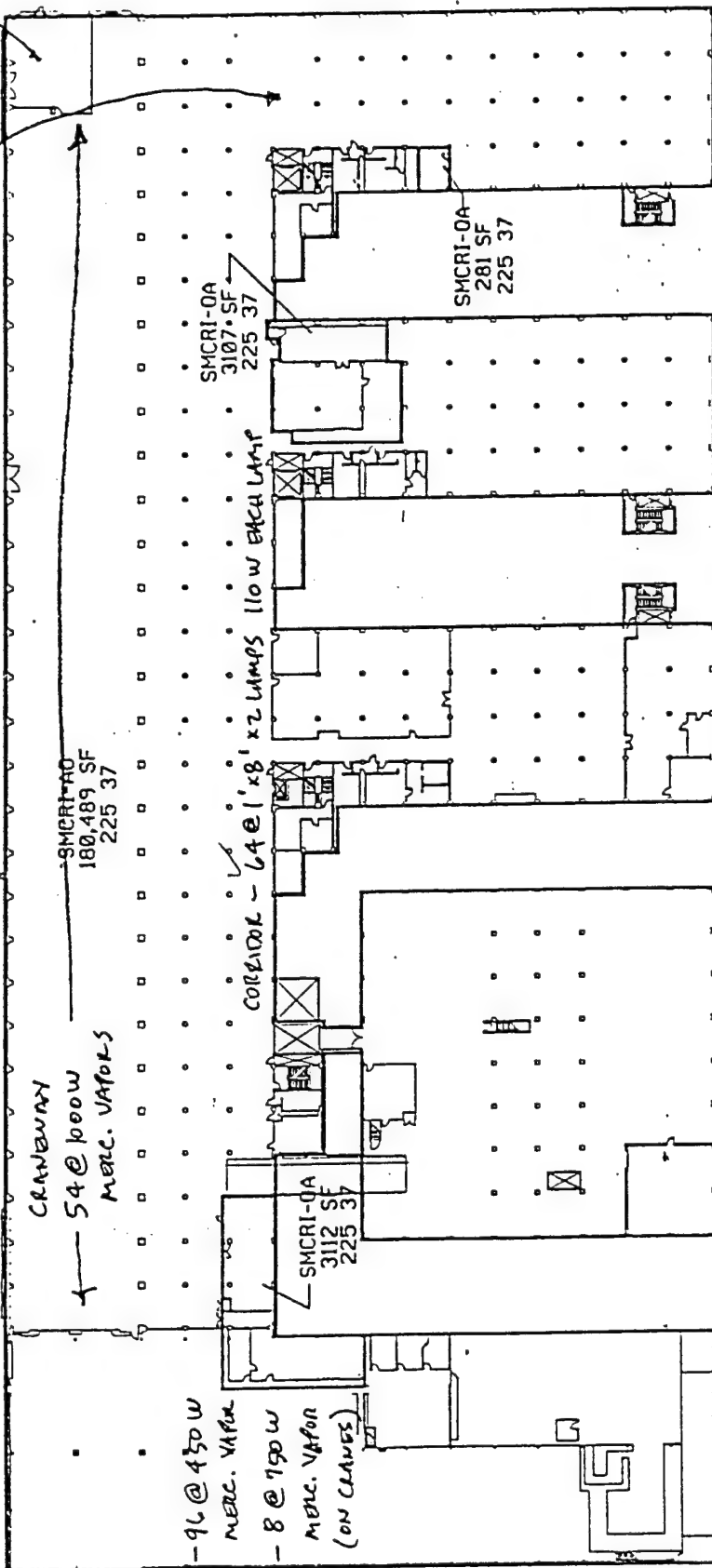
✓ 136 @ 2'x4' x 2 Lamps - 34 WATTS
 ✓ 40 @ 1'x8' x 2 Lamps - 60 WATTS
 4 @ 300 WATT INCANDESCENTS

✓ CORRIDOR - 35 @ 1'x4' x 2 Lamps @ 34 W



✓ 98 @ 1'x8' x 2 lamps @ 110 w each
 ✓ 14 @ 2'x4' x 2 lamps @ 34 w each

✓ 3 @ 8' x 2 lamps
 60 w



ROCK ISLAND ARSENAL
 DIRECTORATE OF ENGINEERING & HOUSING
 ENGINEERING & SERVICES BRANCH

BUILDING 220
 FIRST FLOOR

SCALE 1" = 10'

REV. SEP 1944

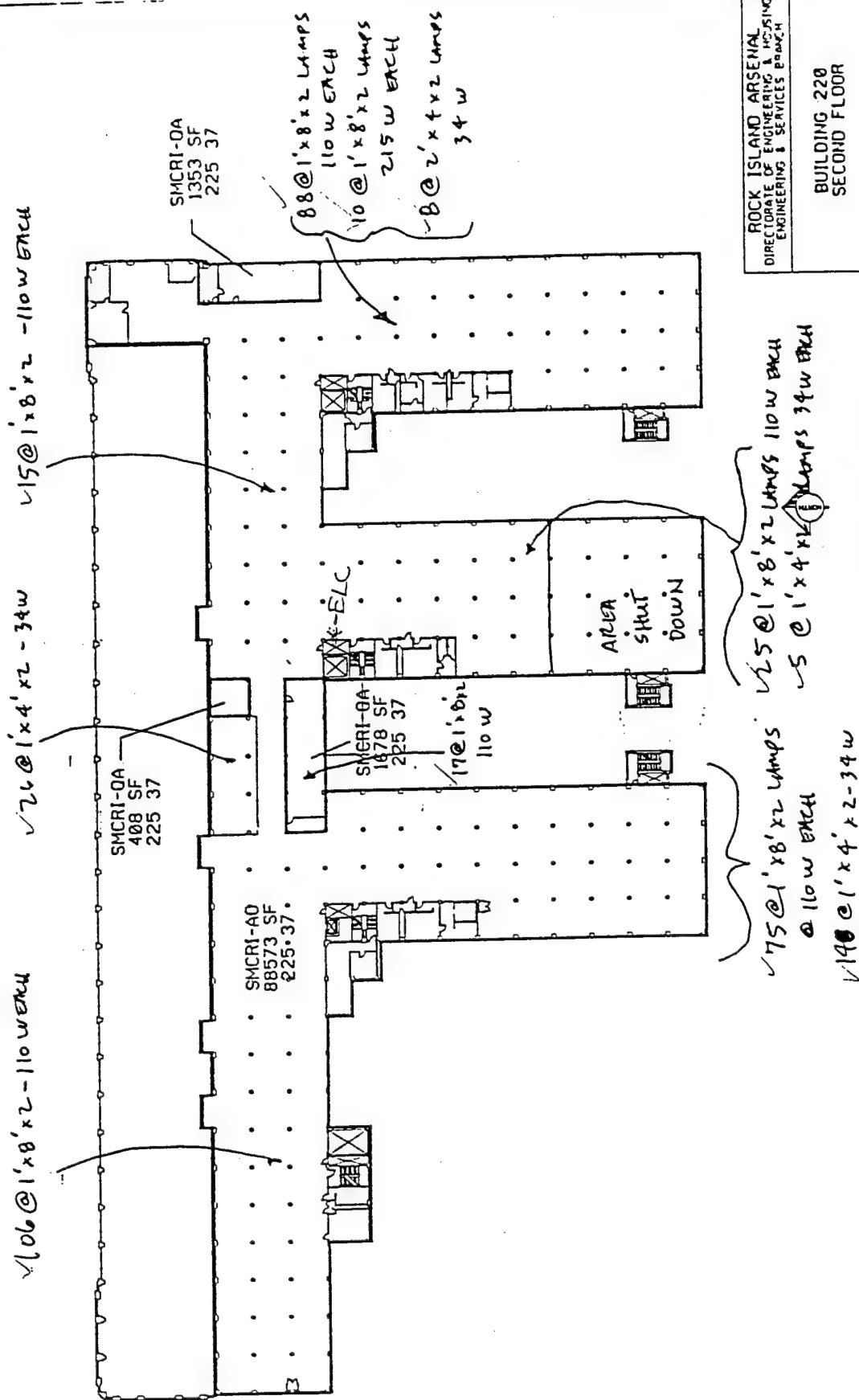
✓ 96 @ 1'x8' x 2' - 110 w
 ✓ 13 @ 1'x4' x 2' - 34 w

✓ 62 @ 1'x8' x 2' - 110 w
 ✓ 63 @ 2'x4' x 2' - 34 w

✓ 115 @ 1'x8' x 2' - 110 w each
 ✓ 63 @ 2'x4' x 2' - 34 w

GROSS AREA = 186,989 SF
 OCT 90

7 EXIT SIGNS - INCANDESCENT



ROCK ISLAND ARSENAL
OFFICE OF ENGINEERING & ARCHITECTURE
ENGINEERING & SERVICES BRANCH

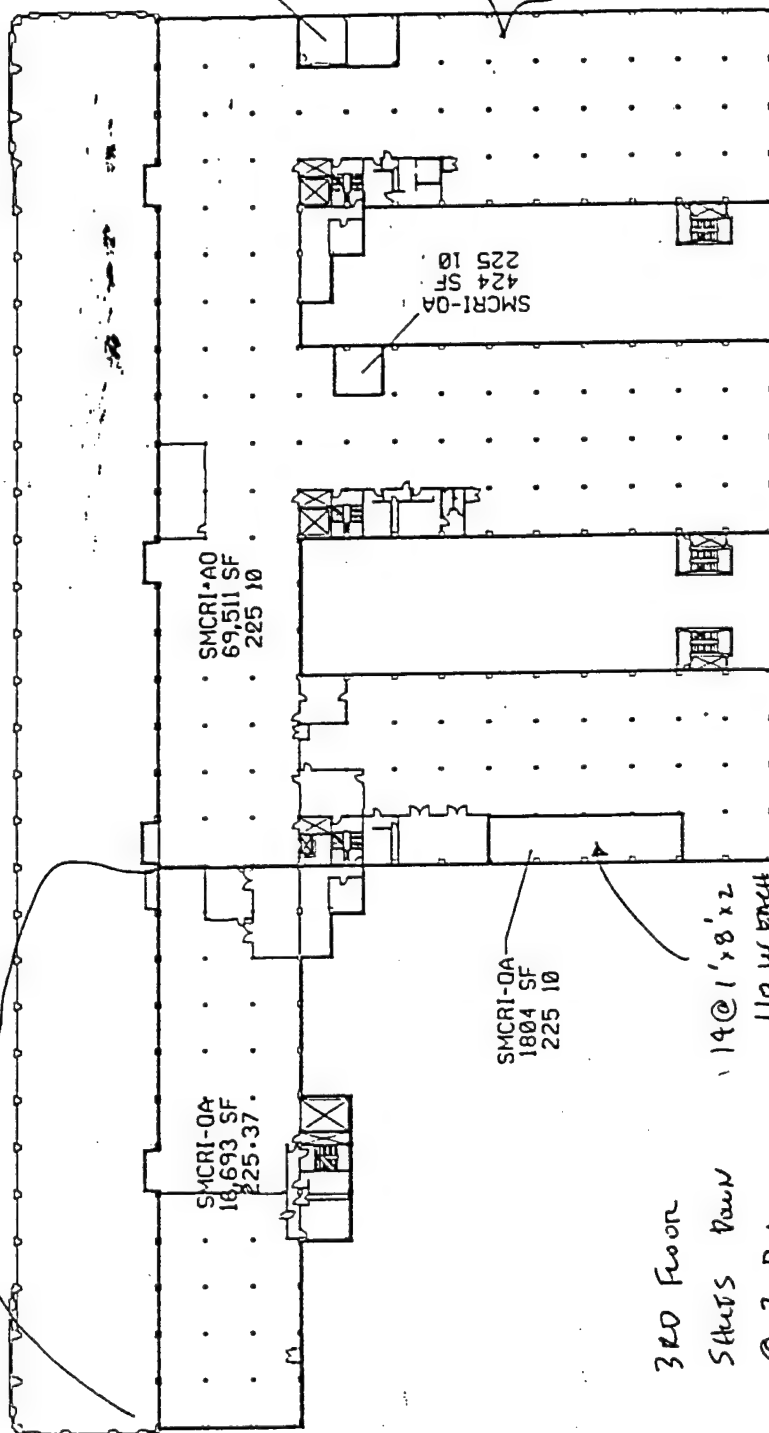
BUILDING 220
SECOND FLOOR

GROSS AREA = 92,012 SF
OCT 90

5 EXIT SIGNS - NEAR DESCENT

- ✓ - 18 @ 2'x4'x2 Lamps. 34w each
- ✓ - 78 @ 1'x8'x2 Lamps

110w each



SMCRI-OA
924 SF
225 10

SMCRI-OA
424 SF
225 10

SMCRI-OA
69,511 SF
225 10

SMCRI-OA
1804 SF
225 10

✓ 58 @ 1'x8'x2
110w each
✓ 6 @ 2'x4'x2
34w each

3RD Floor
Starts down
@ 3 P.M.

✓ 14 @ 1'x8'x2
110w each

✓ 88 @ 1'x4'x2
34w each

✓ 100 @ 1'x8'x2
110w each

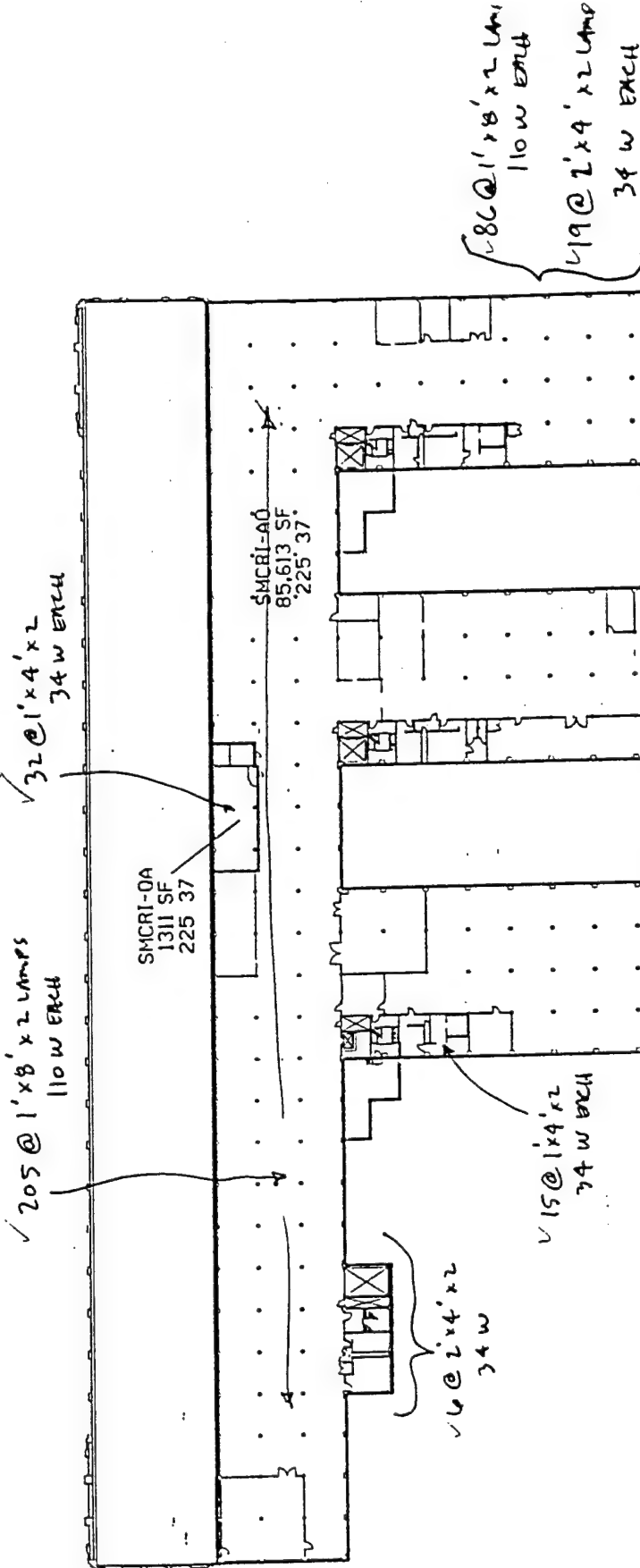
✓ 11 @ 1'x4'x2
34w each
GROSS AREA = 89,356 SF
OCT 90

6 EXIT SIGNS - INCANDESCENT

ROCK ISLAND ARSENAL
DIRECTORATE OF ENGINEERING & HOUSING
ENGINEERING & SERVICES BRANCH

BUILDING 220
THIRD FLOOR

SCALE 1/4" = 1'-0"
REV. OCT 1968



Fourth Floor
Shuts down @ 3 P.M.

GROSS AREA = 86,924 SF
OCT 90

8 EXIT SIGNS - INCANDESCENT

ROCK ISLAND ARSENAL
DIRECTORATE OF ENGINEERING & HOUSING
ENGINEERING & SERVICES BRANCH

BUILDING 220
FOURTH FLOOR



REV. OCT 1999

BLDG. 350 - ADMINISTRATION AREA

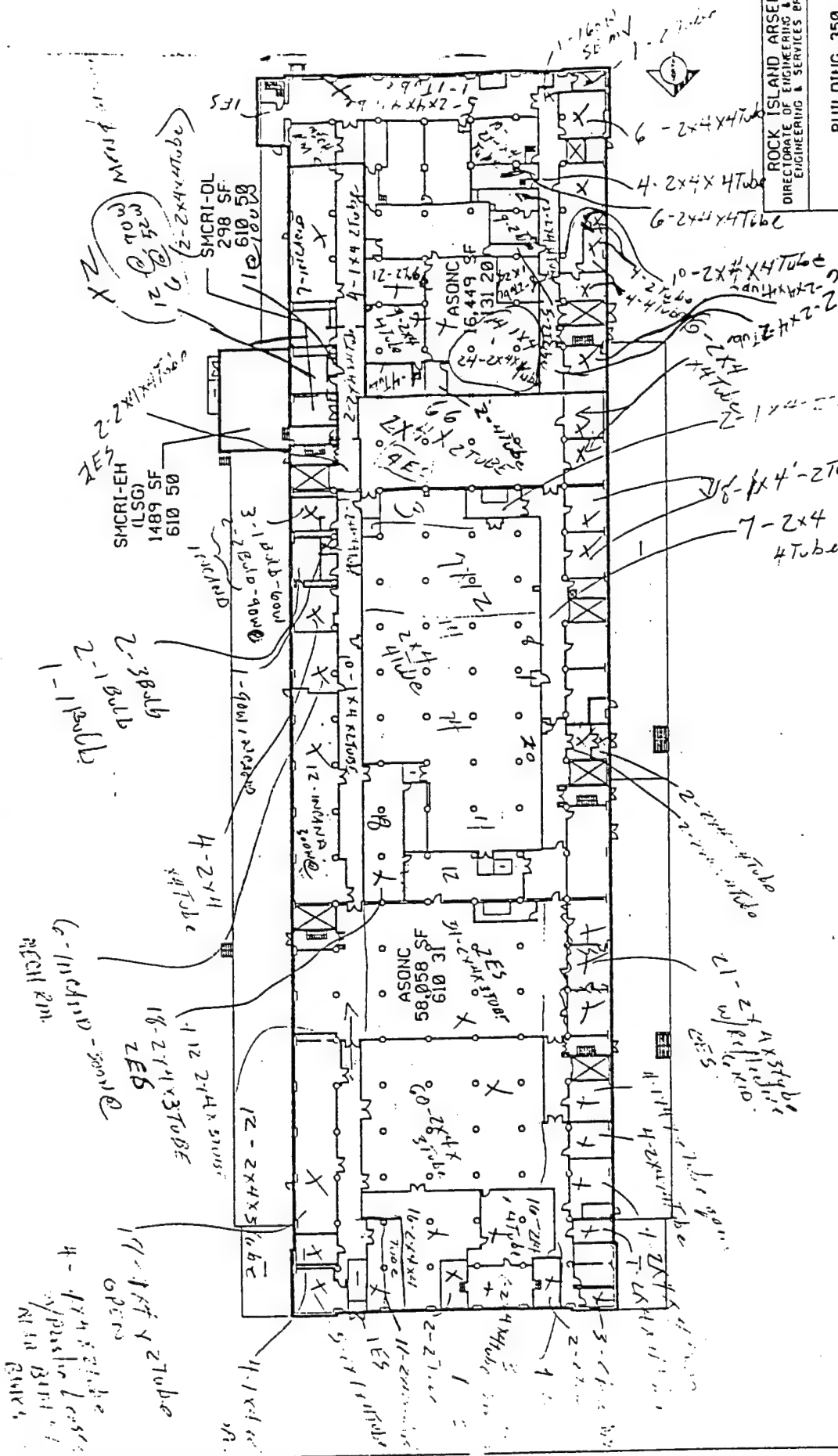
CODE	OFFICE	QTY	DESCRIPTION	MINIMUM F.C. REQ'D
1335	462	<u>1847</u>	2'x4' LAY-IN 4 TUBE 40 W/TUBE - 60 F.C. - 8'	MTG. HG
673	225	<u>898</u>	2'x4' LAY-IN 3 TUBE 40 W/TUBE - 60 FC - 8'	MTG. H
239	296	<u>1185</u>	2'x4' LAY-IN 2 TUBE 40 W/TUBE - 50 FC - 8'	MTG. H
283	94	<u>377</u>	2'x4' SURFACE MOUNT 2 TUBE 40 W/TUBE - 50 FC - 8'	MTG
34	0	<u>34</u>	1'x4' SURFACE MOUNT 4 TUBE 40 W/TUBE - 50 FC - 9'	MTG
57	219	<u>876</u>	1'x4' SURFACE MOUNT 2 TUBE 40 W/TUBE - 50 FC - 9'	MTG
0	18	<u>18</u>	2'x2' U-TUBE FLUSH MTD. 2 TUBE 39 W/TUBE - 50 FC - 8'	MT
00	0	<u>100</u>	1'x8' 2 TUBE SURFACE MTD. 60 W/TUBE - 50 FC - 9'	
		<u>78</u>	300 W INCAND. SINGLE BULB FIXTURES IN - 10-20 FC - 9'	MECH. ROOMS
		<u>9</u>	200 W INCAND. SINGLE BULB FIXTURES IN - 10-20 FC - 9'	MECH. ROOMS
		<u>63</u>	90 W INCAND IN REST ROOMS - 20-30 FC - 8'	MT.
			(THERE ARE 21 TOTAL FIXTURES W/3 BULBS EACH = 63)	
		<u>122</u>	SINGLE LAMP 60 W FIXTURES (IN RESTROOMS AND STAIRWELLS) - 10-20 FC - 9'	MTG
		<u>40</u>	75 W ^{RECESSED} DOWN LIGHTS ON DIMMERS (PRIMARY IN CONFERENCE ROOMS)	
		<u>79</u>	INCANDESCENT EXIT SIGNS W/2@20 W TUBES EACH	

Title	Checked By	Date
	Prepared By	Sheet No.
Project	Job No.	

BUILDING 350
FIRST FLOOR

SCALE 1" = 10'
REV. OCT 1949

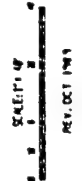
GROSS AREA = 76,294 SF
OCT 90





ROCK ISLAND ARSENAL
DIRECTORATE OF ENGINEERING & HOLM
ENGINEERING & SERVICES BRANCH

BUILDING 350
SECOND FLOOR



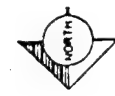
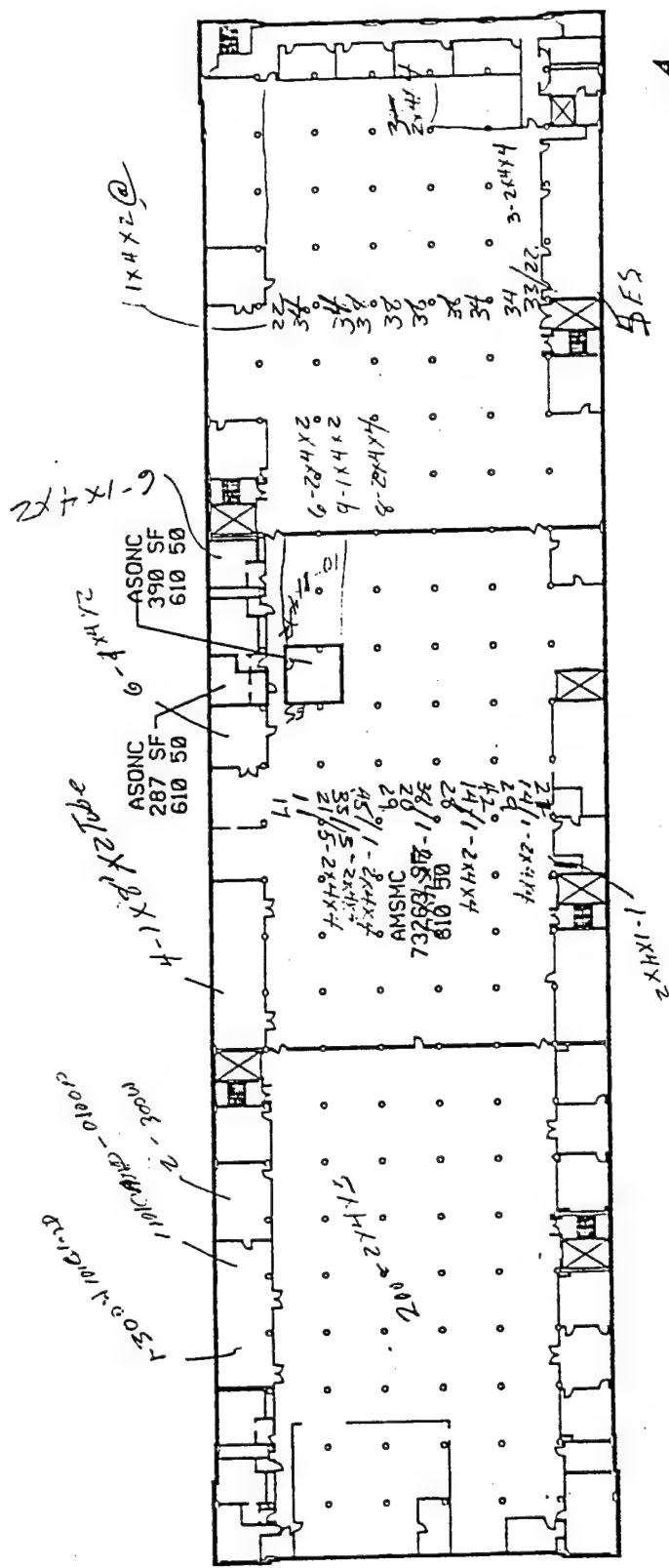
12-9



BUILDING 350
THIRD FLOOR

SECRET
NOV 19 1946

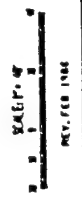
12-10



GROSS AREA = 73940 SF
OCT 90

ROCK ISLAND ARSENAL
DIRECTORATE OF ENGINEERING & ARCHITECTURE
ENGINEERING & SERVICES BRANCH

BUILDING 350
FOURTH FLOOR



OCT 9,

ROCK ISLAND ARSENAL
DIRECTORATE OF ENGINEERING & ARCHITECTURE
ENGINEERING & SERVICES BRANCH

BUILDING 350
FIFTH FLOOR

SCALE: 1" = 10'
DATE: FEB 1966

20' x 12' 10" (60")
16' 4" x 27' 6" (100")

2' 10" x 6' 4" (70")
19' 11" x 16' 4" (50")

IASSG
3828
610 50

16' 5" (50")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

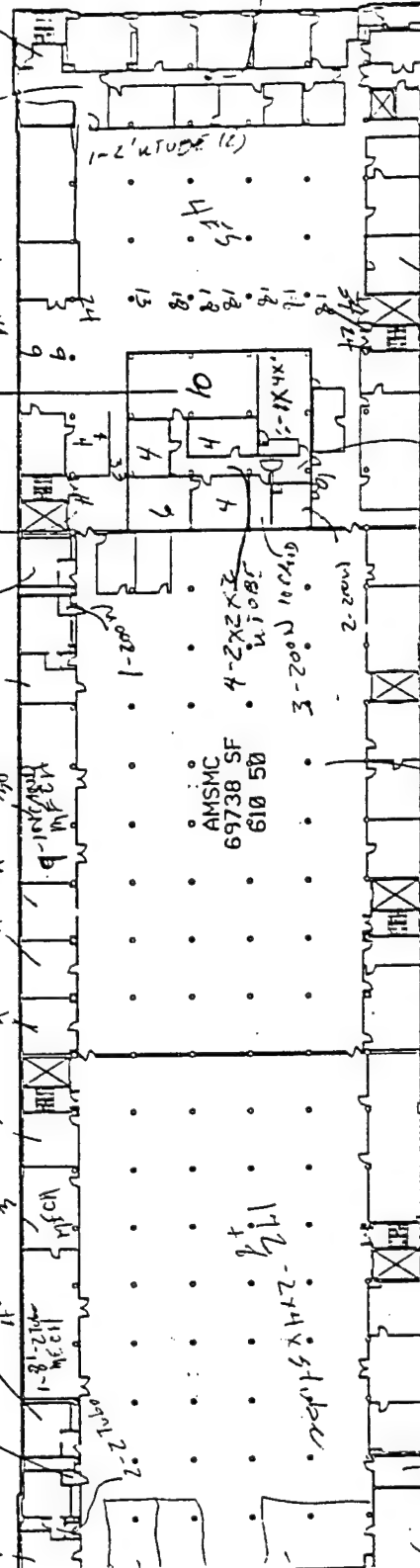
4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")



MCLNO-LMA
2-2X2/375 SF
610 50

GROSS AREA = 73941 SF

2-1X2X2/FLOOR

21' 6" x 11' 3" (30")

16' 5" (50")

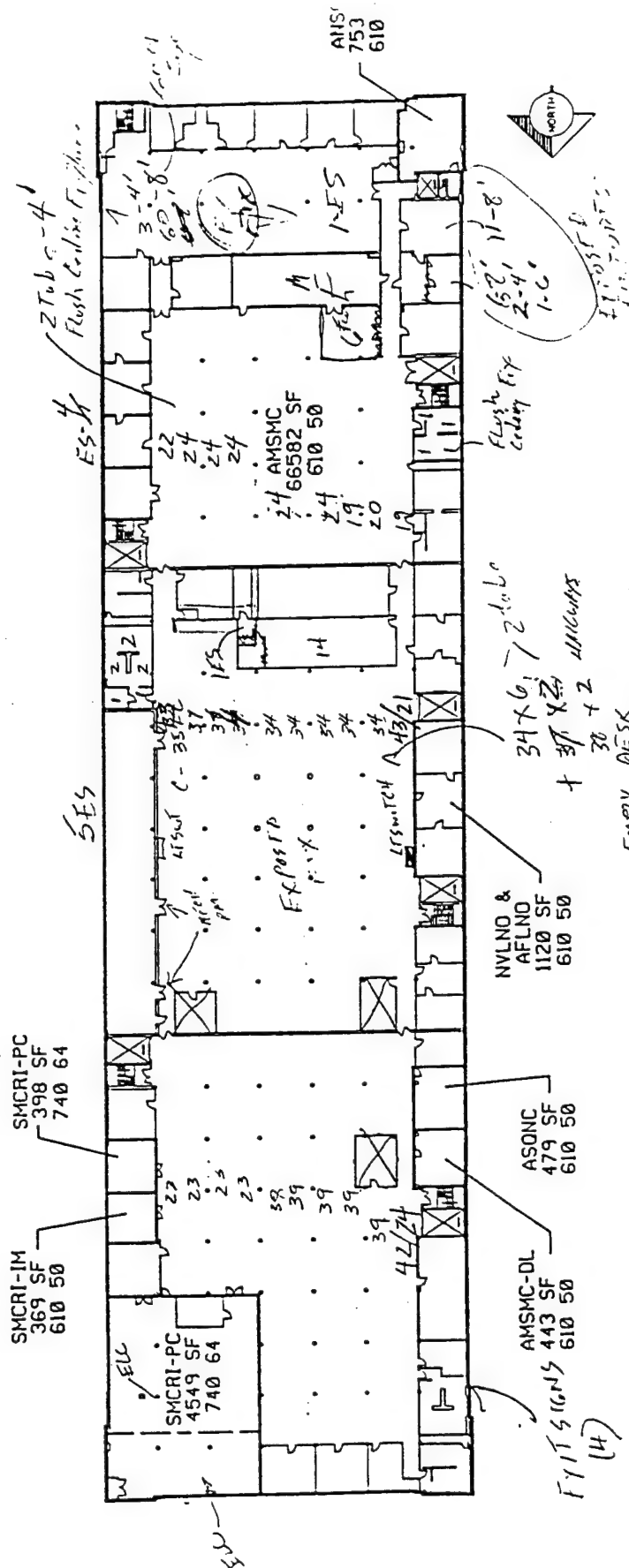
4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")

4' 2" x 11' 3" (30")



ROCK ISLAND ARSENAL
DIRECTORATE OF ENGINEERING & ARCHITECTURE
ENGINEERING & SERVICES BRANCH

BUILDING 350
SIXTH FLOOR

SCALE: 1" = 10'-0"
REV. FEB 1946

EMPTY DESK
34 Lamps w/ Task. under flyline
21 Lamps w/ Task. under flyline
GROSS AREA = 73940 SF
OCT 90
12 FC IN BETWEEN FIXTURES AND DESK

OPTION-ROCK ISLAND ARSENAL, IL & OPTION-FORT KNOX, KY
SCOPE OF WORK
FOR A
LIMITED ENERGY STUDY (LES)

TABLE OF CONTENTS

1. BRIEF DESCRIPTION OF WORK
2. GENERAL
3. PROJECT MANAGEMENT
4. SERVICES AND MATERIALS
5. PROJECT DOCUMENTATION
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 - 5.2 Non-ECIP Projects
 - 5.3 Nonfeasible ECOs
6. DETAILED SCOPE OF WORK
7. WORK TO BE ACCOMPLISHED
 - 7.1 Review Previous Studies
 - 7.2 Perform a Limited Site Survey
 - 7.3 Reevaluate Selected Projects
 - 7.4 Evaluate Selected ECOs
 - 7.5 Combine ECOs into Recommended Projects
 - 7.6 Submittals, Presentations and Reviews

ANNEXES

- A - DETAILED SCOPE OF WORK
- B - EXECUTIVE SUMMARY GUIDELINE
- C - REQUIRED DD FORM 1391 DATA
- GLOSSARY OF ACCRONYMS

1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (A/E) shall:

1.1 Review the previously completed Energy Engineering Analysis Program (EEAP) study which applies to the specific building, system, or energy conservation opportunity (ECO) covered by this study.

1.2 Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.

1.3 Reevaluate the specific project or ECO from the previous study to determine its economic feasibility based on revised criteria, current site conditions and technical applicability.

1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

1.5 Provide project documentation for recommended ECOs as detailed herein.

1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. GENERAL

2.1 This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.

2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.

2.3 For the buildings, systems or ECOs listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.

2.4 The study shall consider the use of all energy sources applicable to each building, system, or ECO.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from CEHSC-FU, dated 4 Nov 1992 and the latest revision from CEHSC-FU establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis (LCCA), it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer.

2.6 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The requirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of

simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month. The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the A/E desires to use a different program, it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP, MCA, or PCIP funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.

2.7.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.7.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

2.7.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.

3. PROJECT MANAGEMENT

3.1 Project Managers. The A/E shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The A/E's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the installation will designate an individual to assist the A/E in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.

3.3 Public Disclosures. The A/E shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The A/E's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The A/E shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The A/E shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the A/E and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The A/E shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The A/E shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The A/E shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The A/E and the Government's representative shall conduct entry and exit interviews with the Director of Engineering and Housing (DEH) before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

- a. Schedules.
- b. Names of energy analysts who will be conducting the site survey.
- c. Proposed working hours.
- d. Support requirements from the Director of Engineering and Housing.

3.7.2 Exit. The exit interview shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the DEH.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, supervision and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All ECOs which the A/E has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than \$300,000, a Savings to Investment Ratio (SIR) greater than one and a simple payback period of less than ten years. For ECAM projects, the \$300,000 limitation may not apply; in such cases, the AE shall check with the installation for guidance. The overall project and each discrete part of the project shall have an SIR greater than one. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented), and a Project

Development Brochure (PDB). A LCCA summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. For projects and ECOs reevaluated from previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work under which the project or ECO was developed in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. The purpose of this information is to provide a means to prevent duplication of projects in any future reports.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate or payback period, but which have an SIR greater than one shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.7.2 and shall be provided with the following documentation: the LCCA summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA, ie, energy savings calculations and cost estimate(s), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost greater than \$3,000 but less than \$100,000 and a simple payback period of two years or less.

b. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of greater than \$3,000 but less than \$100,000 and a simple payback period of four years or less.

c. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost of more than \$100,000 and a simple payback period of four years or less.

The above programs and the required documentation forms are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than \$300,000 and a simple payback period of four to twenty-five years. Documentation shall consist of DD Form 1391 and a PDB.

e. Low Cost/No Cost Projects. These are projects which the DEH can perform using his resources. Documentation shall be as required by the DEH.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. Review the previous EEAP study which applies to the specific building, system, or ECO covered by this study. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the ECOs in

this study may be contained in the previous study.

7.2 Perform a Limited Site Survey. The A/E shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the A/E is encouraged to use any data that may have been documented in a previous study. The A/E shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3 Reevaluate Selected Projects. The A/E shall reevaluate the projects and ECOs listed in Annex A. These are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings, the energy costs and construction costs shall be updated, and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

7.4 Evaluate Selected ECOs. The A/E shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. SIRs shall be determined using current ECIP guidance. The A/E shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A LCCA summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph 7.6.1, the A/E will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per paragraph 7.6.2.

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The A/E shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day,

following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the DEH, the A/E and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

a. All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b. All ECOs which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in descending order SIR. These lists may be subdivided by building or area as appropriate for the study.

The A/E shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and A/E's representatives shall coordinate with the DEH to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Final Submittal. The A/E shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The A/E shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph 7.6.1 shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (see Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

- 1) Energy cost development and backup data
- 2) Detailed calculations
- 3) Cost estimates
- 4) Computer printouts (where applicable)
- 5) Scope of Work

LOUISVILLE DISTRICT CORPS OF ENGINEERS
ENGINEERING DIVISION, A/E MANAGEMENT BRANCH (CEORL-ED-M)

ANNEX A
DETAILED SCOPE OF WORK
ROCK ISLAND ARSENAL, IL (Option)
May 10, 1993

1. PROJECT NAME & LOCATION: Option- FY93Y Rock Island Arsenal Limited Energy Study (LES), Lighting survey in manufacturing and office areas, and an analysis/ recommendation for a natural gas-powered peak shaving, and/or co-generator system as ECOs are as follows:

A. Lighting survey for Machine Shop, Building 220 is a 4-story structure, with a partial basement having 536,970 square feet. Location on Rodman Avenue at Flagler Avenue. See Figure A-1.1, Location Map.

B. Lighting survey for Administrative Office, Building 350 is a 6-story structure having 453,600 square feet. Building 350 is a converted warehouse facility to administrative use. It is located on Rodman Avenue between W. Pershing Circle and Buffington Drive. See Figure A-1.1, Location Map.

C. A Natural Gas-Powered Peak Shaving, and/or Co-Generator System for electric to be located at Hydro-Electric Plant, Building 160. The existing peak shaving generator was a 2,400 volt, 1194 KVA, 955 KW Diesel-driven generator, which is not in working condition, is disconnected from the system, and will be excessed before this project begins. It is located is on East Avenue at Beck Lane. See Figure A-1.1, Location Map.

2. GENERAL SOW vs. DETAILED SOW: The General Scope of Work (GSOW) will apply to contract efforts as modified by the Detailed SOW. Should conflicts occur between the GSOW and the Detailed SOW, the Detailed SOW shall govern.

3. RESPECTIVE POC's for this study:

Louisville District COE- Charles Lockman/CEORL-ED-M
(502) 582-6041, fax#6763

Rock Island Arsenal DEH- David Osborn/SMCRI-EHS
(309) 782-2393, fax#2550

Architect/Engineer(A/E)-

4. SCOPE:

4.1 The A/E shall provide all work necessary to complete the Limited Energy Study as defined by the GSOW including the Annexes. Information and instructions contained within the DSOW are provided as a means for the A/E Project Manager to expand or modify the GSOW as may be needed to suit the study for the three project areas listed in 1. above. This LES is much more flexible than the standard EEAP study, and is meant to address specific opportunities, buildings or systems that the installation feels have high potential for energy or dollar savings.

4.2 The study will analyze a lighting survey ECO in Bldg. 220 and Bldg. 350, and make recommendations for a new natural gas-powered peak shaving generator at Bldg. 160 for the facilities use by the Using Agency, material, utilities, and other components of the industrial operation, and determine any energy savings methods/ recommendations for this study. This includes interview of personnel to gather data for quantities, and operational data. Alternate energy sources such as solar, wind, geothermal, will not be included.

4.3 The study will consider new designs for energy trends that make these facilities more cost effective and energy saving.

4.4 If metering of a facility is required, the A/E shall assist the DEH in arranging for the installation of electrical metering, however, existing data is available at the installation, and by other studies/ surveys.

5. DETAILED REQUIREMENTS: All detail requirements selected at Rock Island Arsenal for the purpose of this study, shall specifically include the specific facilities listed in paragraph 1. above and projects identified by the DEH staff.

In general, the facilities and projects, when investigated relative to the ECO's provided as follows:

- A. Building 220, Machine Shop:
 - a. Project or ECO's from previous studies:
 - 1. None
 - b. Existing relatable EEAP documentation of the building:
 - 1. Energy Survey of Industrial Facilities, dated April 1989
 - 2. Energy Monitoring and Control System, dated 1 July 1984
 - 3. EEAP, ECIP Project #1, Bldg. 220, dated July 1982.
 - c. New ECO's:
 - 1. Lighting and levels of light recommendations/analysis
 - 2. Motion/photocell lighting controls.
 - 3. Controls on lighting by areas/zones of need.
- B. Building 350, Admin. Office:
 - a. Project for ECO's from previous studies:
 - 1. None
 - b. Existing relatable EEAP documentation of the building:
 - 1. Electrical Distribution Study, Bldg. 350, dated July 1987, by Black & Veatch.
 - 2. EEAP, Interim Report, dated 1982, by GARD, Inc.
 - c. New ECO's:
 - 1. Lighting and levels of light
 - 2. Motion/photocell lighting controls.
 - 3. Controls on lighting by areas of need.
- C. Building 160, Hydro-Electric Plant:
 - a. Project for ECO's from previous studies:
 - 1. None
 - b. Existing relatable EEAP documentation of the facility:
 - 1. Analytical and Environmental Assessment Report, dated May 1983 by Harland Bartholomew & Associates, Inc., Section 4, page 75.
 - 2. Economic Analysis, Hydroelectric Power Plant, COE, May 1983.
 - c. New ECO's:
 - 1. Natural Gas-Powered Peak Shaving, and/or Co Generator System

The contractor will review existing building drawings, survey and monitor existing lights, and analyze the listed ECO's, and analyze additional ECO's readily discovered during the field survey.

6. PERFORMANCE: The total time required for completion of the study and the performance of all work shall not be more than 120 calendar days from the Notice to Proceed (NTP) on the contract. If the study takes the A/E less time than scheduled to achieve, a shortened schedule for submittal and coordination of review and interim review meeting at the installation may be coordinated by the A/E with all parties involved in the review process. Figure A-6.1 is a

schedule of pertinent events and milestone dates for acceptable performance of the study at Rock Island Arsenal. Changes or adjustments made to the SOW during the term of the project study shall be made by the COE.

7. SUBMITTALS: The A/E's Project Manager shall provide direct distribution of all required submittals and documents in the numbers as listed in Figure A-7.1.

8. GOVERNMENT-FURNISHED INFORMATION: The following list of reference documents will be furnished to the A/E:

a. ETSS 1110-3-254, Use of Electric Power for Comfort Space Heating (if applicable), and 1110-3-282 Energy Conservation

b. Energy Conservation Investment Program (ECIP) Guidance, dated 4 Nov 1992 and the latest revision with current energy prices and discount factors for life cycle cost analysis.

c. TM 5-785, Engineering Weather Data.

B-3

d. AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

e. AR 415-15, 1 Jan 84, Military Construction, Army (MCA) Program Development

f. The latest MCP Index.

g. Drawings at the DEH of each facility.

h. Reports listed in ECO information listed above which will assist in the development of the study for each facility.

9. LCCID FROM BLAST: A computer program titled Life Cycle Costing in Design (LCCID) will be used and is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. This computer program will be used for performing the economic calculations for ECIP and non-ECIP ECOs. The A/E is encouraged to obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (217) 333-3977, or (800) 842-5478.

10. If it is possible that the buildings in this study will be subject to the computer modeling requirements of paragraph 2.6 of the GSOW, then the simulation programs acceptable to the office doing the technical review should be listed in the detailed scope of work. Some acceptable simulation programs follow:

a. Building Loads and System Thermodynamics (BLAST) *

b. DOE 2.1B *

c. Carrier E20 or Hourly Analysis Program (HAP) **

d. Trane Air-Conditioning Economics (TRACE) **

* Very accurate, but requires a lot of time for input; therefore it is rather expensive for straightforward projects.

** Adequate for load determination, equipment selection, and energy performance for most projects.

11. LIST OF EEAP STUDIES/REPORTS, ROCK ISLAND ARSENAL: A review of the following is considered to be of assistance for in the GSOW. The COE and DEH Offices have a copy for review, and/or loan:

- a. EEAP, Hydroelectric Power Plant, 05/01/83
- b. EEAP, Increment B, 05/01/82
- c. EEAP, Vol. 1, Interim Report, 06/01/81
- d. EEAP, Vol. 2, Appendix A, 06/01/81
- e. EEAP, Vol. 3, Appendix B, 06/01/81
- f. EEAP, Part 1 OF 2, ECIP 1-4, 07/01/84
- g. EEAP, Part 2 of 2, ECIP 5-8, 07/01/84
- h. EMCS, for 31 Buildings, 07/01/84
- i. Electrical Dist. Study Bldg.#350, 07/01/87
- j. Energy Monitoring and Control System, 07/01/87
- k. Energy Survey of Industrial Facilities, 07/01/89
- l. Analytical & Environmental Assessment Report, 05/01/83

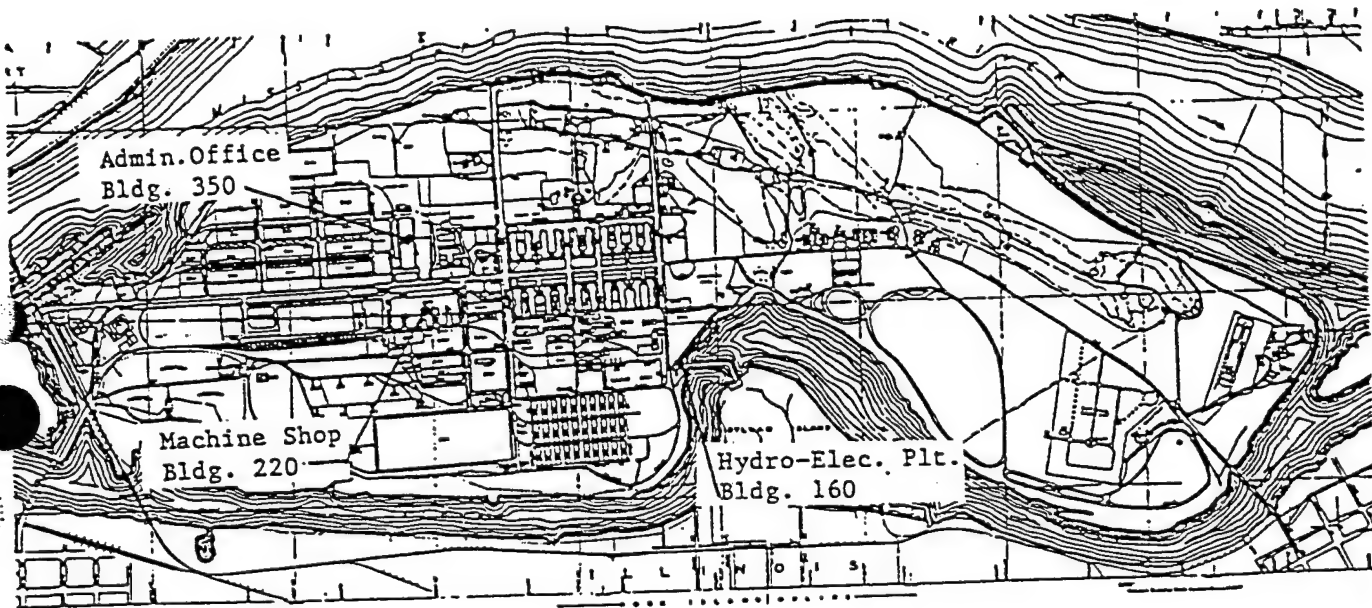
Figure A-1.1 - ROCK ISLAND ARSENAL

LIMITED ENERGY STUDY- LIGHTING SURVEY, Bldg. 220, and 350; and GAS-POWERED
PEAK SAVING GENERATOR, Bldg. 160.

ENERGY ENGINEERING ANALYSIS PROGRAM

PROJECTS
LOCATION MAP

U. S. ARMY
ROCK ISLAND ARSENAL, ILLINOIS



U. S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

FIGURE A-6.1. SCHEDULE for Option LES, FY93Y EEAP, Rock Island Arsenal (RIA), IL, if awarded simultaneously w/contract:

<u>Item</u>	<u>Calendar Days</u>	<u>Actual Date</u>
1. CBD ANNOUNCEMENT.....0	..	16 Mar 93
2. CBD CLOSED.....0	..	15 Apr 93
3. SOW APPROVED BY COE/DEH/MACOM.....0	..	15 Apr 93
4. PRESELECTION/SELECTION BOARD.....0	..	6/7May 93
5. RFP LETTER TO A/E.....0	..	18 May 93
6. RFP LETTER RECEIVED BY A/E.....0 (COE, MACOM, DEH, and A/E coordinates date)	..	20 May 93
7. ENTRY INTERVIEW @ Rock Island Arsenal (RIA)..0 (prior to Pre-SOW Mtg. DEH, COE, and A/E)	..	1/2 Jn 93
8. PRE-NEGOTIATION SCOPING MEETING @ RIA.....0 (for RFP, neg'ns, scoping w/DEH, COE, MACOM)	..	1/2 Jn 93
9.a A/E SUBMITS PROPOSAL/NEG'Ns BEGIN.....0	..	10 Jun 93
b Negotiations begin/ends		14-18J 93
10. AWARDability OF CONTRACT-START/NTP.....1 (field analysis begins by A/E, SAF)	..	28-30J 93
11. INTERIM SUBMITTAL @ 40%.....60 (all field work completed/ECO's analyzed)	..	01 Sep 93
12. REVIEW PERIOD OF THE INTERIM SUBMITTAL.....75 (COE gathers comments from IN-HOUSE/DEH/MACOM)	..	15 Sep 93
13. INTERIM REVIEW MEETING @ RIA.....76 (COE, MACOM, DEH, A/E, & others)	..	17 Sep 93
14. EXIT INTERVIEW MTG. @ RIA.....76	..	17 Sep 93
15. FINAL SUBMITTAL.....120 (A/E sends directly to as listed, herein)	..	01 Nov 93
16. DEH may require to have input on the DD 175 Form 1391 from A/E	..	06 Dec 93
17. DEH SUBMITS DD Form 1391's.....		03 Jan 94

NOTE: Option, Phase II, if awarded separately, will follow 10. through 17. listed above for the schedule

FIGURE A-7.1. Distribution of Submittals: The A/E shall make direct submittal and responses to comments as indicated by the following schedule:

Responses to comments as indicated by the red

Organization	Correspondence			
		Executive Summary		
		Reports	Fieldnotes	
COMMANDER, US Army Engineer District, Louisville ATTN: CEORL-ED-M/Charles Lockman P.O. Box 59 Louisville, KY 40201-0059 (tel. 502-582-6041, or fax# 6763, or 5281)	1	1	3	1*
COMMANDER, Rock Island Arsenal ATTN: SMCRI-EHS/David Osborn Rock Island, IL 61299-5000 (tel. 309-782-2393, or fax# 2550)	1	1	1	1*
HQ AMCCOM, Rock Island Arsenal (MACOM) ATTN: AMCCOM/Bob Burchett, Energy Officer Rock Island, IL 61299-5000 (tel. 309-782-1410)	1	1	1	1*
COMMANDER, US Army Engineer District, Mobile ATTN: CESAM-EN-CC/Tony Battaglia (EEAP TCX) P.O. Box 2288 Mobile, AL 36628-0001 (tel. 205-690-2618, or fax# 2424)	1	1**0		0
COMMANDER, US Army Engineer Div., Ohio River ATTN: CEORD-DL-M/Joe Semrad P.O. Box 1159 Cincinnati, OH 45201-1159 (tel. 513-684-3975)	0	1**0		0
COMMANDER, US Army Corps of Engineers ATTN: CEMP-ET/Dan Gentil (EEAP Mgr.) 20 Massachusetts Avenue Washington, D.C. 20314-1000 (tel. 202-272-0430)	0	1**0		0
COMMANDER, US Army Logistics Evaluation Agency ATTN: LOEA-PL/Mr. Keath New Cumberland Army Depot New Cumberland, Pa. 17070-5006	0	1**0		0

* Field Notes submitted in final at Interim submittal.
** Submit copies of the final Executive Summary Only

14 Comments and Responses

14.1 INTERIM REVIEW COMMENTS AND RESPONSES

The interim review conference was held at Rock Island Arsenal on October 15, 1993. The attendees were as follows:

	<u>ORGANIZATION</u>	<u>PHONE #</u>
Jimmy Braden	Rock Island Arsenal	309-782-2669
Gary Cook	Rock Island Arsenal	309-782-2669
Charles Lockman	C.O.E. - Louisville District	502-582-6041
Greg Loflin	Systems Corp	615-521-6536
Dave Osborn	Rock Island Arsenal	309-782-2393

A slide presentation of the Interim Report results was presented by Mr. Loflin. No formal project review comment forms were submitted to Systems Corp; however, an informal discussion of review comments did take place. The following is a summary of the significant comments and Systems Corp's response to each:

COMMENT: Would like to see sample cut sheets of technologies proposed in each project.

RESPONSE: Cut sheets will be included in Final Report.

COMMENT: Do we need to include photometric layouts of the lighting projects in the report?

RESPONSE: The lighting layout improvements may be approached in many different ways. The purpose of this study is to determine the economic feasibility of the project without limiting the options for accomplishing the energy savings to a single lighting layout.

COMMENT: It appears that 40 watt fluorescent lamps were used in the calculations for Building 350, but it is not stated in the text of the report.

RESPONSE: Forty watt lamps were used in the calculations as this is what was found during the field survey in Building 350. This will be stated in the Final Report.

14 Comments and Responses

COMMENT: For *ECO - 3: Peak-Shaving/Cogeneration Options* source electricity consumption should be shown.

RESPONSE: Agreed. This will be noted in the Final Report.

COMMENT: The generating equipment for ECO-3 should have dual-fuel capability.

RESPONSE: Agreed. This will be noted in the Final Report.

COMMENT: An investment credit of \$4 million may be taken on ECO-3C, due to a cost avoidance associated with an emergency generator project at Building 350. The proposed ECO-3C will provide back-up power to Building 350 thereby eliminating the need for the \$4 million project.

RESPONSE: Agreed. This will be incorporated into the Life Cycle Cost Analysis for ECO-3C and the Final Report.

COMMENT: The current summer steam load at the Arsenal is approximately 60,000 lbs/hr. The proposed ECO-3C will provide 110,000 lbs/hr--more than enough to shut down operations at the existing coal-fired steam plant for three to four months during the summer. This will enable the Arsenal to save at least \$200,000 in annual maintenance as compared to the current situation.

RESPONSE: Agreed. The \$200,000 annual maintenance savings will be subtracted from the maintenance costs associated with ECO-3C.

COMMENT: The energy security issue regarding Building 350 needs to be properly addressed in the 1391 Form.

RESPONSE: Agreed. This will be included in the Final Report.

COMMENT: The lighting projects (ECO-1 and ECO-2) should be packaged as separate ECIP Projects.

RESPONSE: Agreed. This will be included in the Final Report.

14 **Comments and Responses**

Following the meeting, Systems Corp received a facsimile of Project Review Comment Forms from the Louisville Corps District. See the following two pages for the comments and Systems Corp's responses.

DATE: 10-16-93

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

A-E Support Section

Master Planning

TO: Greg Loflin, Systems Corp (615) 521-6536
Office / Location: Knoxville, TN
FAX Number: (615) 524-7514

Classification: FOUO / UUUU

Priority: ASAP / Routine

Number of Pages (incl header sheet): 2

FROM: Chuck Lockman, CEORL-ED-MS, (502) 582-6041 FAX: (502) 582-6763
=====

SUBJECT: FY93 EEAP, LES @ RIA, II.

The attached comments from the COE's EE's is provided
as comments to the LES. This is the completion
on comments from the COE on the 60 Interim.

14-4

Project Review Comments

Interim ☐ Pre-Final ☐ Final ☐

Project: ☐ Arch. ☐ Civ. ☐ Mech. ☐ Elec. ☐ San. ☐ Env. ☐ File ☐ Other

Location: ☐ P.H.

Reviewed: J. GRADULICH
Name:
Organizer: CEDALEB-D-E

Page 1 of 1
Date: 4/23/83

Comment No.	Vol.	Sec.	Page	COMMENTS	Action Code	RESOLUTIONS (Include location of documents)	No.
1	1	8	8-3	Table 8.2.1 ECO NAME should line up with ECO NUMBER and Baseline Energy consumption	A	WILL BE CORRECTED IN FINAL REPORT.	
2	1	8	8-6	Para. 8.3.6 - The assumption of on-time of lights to be one-half of the baseline should be coordinated with user to verify that surveyed conditions are usual operating procedure.	A	THIS WAS COORDINATED DURING FIELD SURVEY.	
3	1	1	1	THIS is a well presented document.	A	THANK YOU.	

ACTION CODES:

A - Accepted/Consent

D - Action Deferred

H - Non-concur

VE - VE Folders/VEP Attached

W - Withdrawn

14 Comments and Responses

14.2 FINAL REVIEW COMMENTS AND RESPONSE

On December 8, 1993, Systems Corp received comments from the Mobile District on the final submittal of the Rock Island Arsenal limited energy study. Following are those comments and Systems Corp's responses.

FACSIMILE HEADER SHEET

COMMAND/OFFICE	NAME/OFFICE SYMBOL	OFFICE PHONE	FAX
From: USAED Mobile, AL	Tony Battaglia CESAM-EN-CM	(205) 690-2618	(205) 690-2424
To: USAED Louisville, KY	Chuck Lockman CEORL-ED-M	(502) 582-6041	(502) 582-5281
To: SystemsCorp Knoxville, TN	Kieth Derrington Greg Loflin	(615) 521-6536	(615) 524-7514
To: DPW, Energy Rock Island Ar, IL	Dave Osborn SMCRI-PWE	(309) 782-2393	(309) 782-2550

CLASS	PREC	PAGES	DATE-TIME	MO	YR	RELEASER'S SIGNATURE
U	N	4	08 1430	12	93	Anthony N. Battaglia
REMARKS						

space below for communications center use only

Attached are comments on the final submittal for the limited energy study at Rock Island Arsenal. We all have to work together on this one to come up with a project that will be useful for Rock Island.

Thank you,

Tony Battaglia

MOBILE DISTRICT PROJECT REVIEW COMMENTS		Date: 08 Dec 93	Page 1 of 3
To: Chuck Lockman Louisville District, CEORL-ED-M		From: (Section) CESAM-EN-QM (Reviewer) A. Battaglia 205-690-2618	
Project: Limited Energy Study (Lites & Peak Shave) Location: Rock Island Arsenal, IL		Year: FY-92	Line Item No.:
Type of Action: Review final submittal			
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION

✓ 1. General Since the first comments that I made, dated 18 Nov, which were based on just the Executive Summary, I have received the complete report and change pages. These comments, therefore, are based on the full report with change pages incorporated.

✓ 2. Executive Summary The Table of Contents for the Executive Summary does not show the new page numbers for par 1.4, ECIP Projects Developed.

✓ Final Report Table of Contents:
a. The change pages received for the table of contents were pages i, ii, & vi. When these are inserted into the original table of contents, it results in a discontinuity between pages ii & iii. It also results in a list of tables on both page v and page vi.
b. The page number shown for par 1.4 on the new page i is incorrect.

The following comments all pertain to the Final Report. Most of them have been discussed already among myself, Mr. Lockman, Mr. Loflin, Dave Osborn, and Linda Custer.

4. Pg 7-34 LCCA Summary Sheet for EOD 3C:

a. Item 1E, Salvage Value of Existing Equipment: See comment 6 below.

✓ b. The actual values for costs or savings should be shown instead of the asterisks (***).

✓ c. Item 3.A., Annual Recurring Non-Energy Savings: The -\$430,720 should be shown in the annual savings column rather than the discounted savings column.

✓ d. Item 7: The formula (SIR) = (5/1G) is incorrect. Should be (6/1G).

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- ✓ 5. Pg 8-8 Sec 8.3.1.2, third par: Provide documentation to support the lower gas rate, and reference it in this paragraph.
- ✓ 6. Pgs 8-8 & 8-9 Sec 8.3.1.2: How to handle the \$4,000,000 savings on the Emergency Generator project was discussed with Linda Custer of AMC and Arkie Fanning, an expert in LOCA at the Corps' Huntsville Division. The following is recommended. Rather than showing the \$4M as a salvage value, show it as a one-time non-energy savings in the first (or second) year. Using the SPW factor for "year one" from Table B in the ECIP Guidance, the discounted savings would be (.96)(\$4M). By following this strategy, the SIR would still be >1.0, and the construction cost would be correct. Backup documentation must be provided for the \$4M savings. Dave Osborn at Rock Island Arsenal has suggested that some additional savings might be identified in the central steam plant to improve the SIR.
- ✓ 7. Sec 9 Page 9-1: Correct building number; should be 220.
8. ECIPs General ✓
- a. On the front pages of the 1391's, the cost estimates are shown for one lot. This may be sufficient detail for programming, but not enough to define the project. Please attach detailed estimates. For example, for a lighting project, the cost estimate should identify the number and type of lamps or fixtures that are to be replaced or revised and the unit cost for each.
 - ✓ b. The construction cost estimates have not been escalated to the midpoint of construction.
 - ✓ c. Revise the LOCA Summary Sheets to conform to the format of the current (4 Nov 92) ECIP Guidance.

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9. Pg 11-17

a. Item 10 of 1391: This ECO uses the "source" conversion factor for converting KWhrs to MBTU. The Army energy program has not used the "source" conversion factor of 11,600 BTU/KWhr since about 1988. We are now using the "site" conversion factor of 3,413 BTU/KWhr. Please revise the paragraph as needed. This will result in a net increase in energy, but the cost savings will be substantial.

b. Item 11 of 1391: This will have to be revised to agree with the figures presented in Item 10. Also, correct typos in the last line under "Current Situation".

10. Pg 11-22

There are some inconsistencies in the LOCA Summary Sheet for ECIP #3. These can be corrected when revising to the correct format as mentioned in comment 8.c. above:

a. Economic Life: Should be twenty (20) years.

b. Item 1.A., Construction Cost, does not agree with the value shown in the ECO calculations, page 7-34.

c. Item 2.A., will reflect a net increase in electrical energy use as mentioned in comment 9.a. above.

d. Include demand savings.

e. Move the annual recurring non-energy savings to column 3, Annual Savings.

14 Comments and Responses

Response to Mobile District Review Comments

1. Concur.
2. Concur. Has been corrected.
3. Concur. Has been corrected.
4.
 - a. Concur. This has been done as instructed.
 - b. Concur. This is a problem with the LCCID Software which we could not correct. However, we did replace the summary sheet with our own summary sheet generated in WordPerfect.
 - c. Concur. See response to item 4b.
 - d. Concur. See response to item 4b.
5. Concur. This has been done.
6. Concur. However, someone at the Arsenal needs to provide the cost estimates which was done for the emergency generator project at Building 350 for back-up documentation. Suggest that it be inserted at the end of *Section 11*.
7. Concur. This has been corrected.
8.
 - a. Concur. Detailed estimates from other sections of the report have been copied and attached to the 1391 Forms.
 - b. Concur. This has been corrected.
 - c. Concur. This has been corrected.
9.
 - a. Concur. This has been corrected.
 - b. Concur. This has been corrected.
10.
 - a. Concur. This has been corrected.
 - b. Concur. This has been corrected.
 - c. Concur. This has been corrected.
 - d. Concur. This has been corrected.
 - e. Concur. This has been corrected.